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LORD KELVIN LAID TO REST.

With ceremonies befitting one of her greatest sons, England, on Monday, December 23, laid to rest the mortal remains of Lord Kelvin. While Westminster Abbey was crowded with men who have won distinction in all walks of life, the coffin bearing all that remained of our great scientific leader was borne to its last resting place at the foot of Sir Isaac Newton's monument, by representatives of the great scientific and engineering societies. Rarely has such a notable assembly gathered as was here brought together to confer the last honors on one who throughout his long life had ever been an inspiration and a help to all who sought him.

To the generations that follow it may be somewhat difficult to understand the position held by this noble student of science; they most likely will know him better by his most erudite researches; but to those who worked among the pioneers of electrical engineering he was far more than a mere searcher for new facts. He did not disdain to use his highest attainments for the benefit of humanity, and in this his position was almost unique. There are few, if any, who have combined his marvelous theoretical knowledge and clear insight into nature's works with the willingness to use his knowledge for the good of man, with the realization of what such usage meant to the world, and with the skill to bring under man's control nature's forces. For forty years submarine telegraphy has been a marvelous example of his ability, as he not only showed how the cable itself should be constructed, but how it should be laid, and he devised the instruments for controlling the laying and for recording the faint messages as they reach the other end.

In still another field, not usually considered to be within the province of the electrician, Kelvin's great genius devised a solution of a difficult problem and conferred incalculable benefit on mankind. His life at sea, during the laying of the Atlantic cable, brought to his attention the serious faults of the mariner's compass of those days—faults which were much more serious for use on iron vessels. He later devised the compass which to-day is the standard throughout the world, his clear insight into the conditions to be met leading him in a direction opposite to that taken by other inventors, and at the same time he devised a means for compensating for the disturbing influences of neighboring masses of iron, so that the instrument could be relied upon as implicitly on an iron as on a wooden vessel. Thus he brought another great branch of human activity under lasting obligations to him.

There is another side of his great work of which probably but few to-day realize the importance. It was he who said that

until one could measure nature's forces and talk about them in figures he really knew but little. It was this great truth which led him to devise the many exquisite physical instruments which have contributed so greatly to scientific progress. The Thomson galvanometer is but a single example, but it will probably long remain as a classical design to be modified only to meet the special needs of different workers. His labors in this branch of science were remarkable for their wide usefulness. Other great investigators have devised beautiful apparatus to meet their special needs. Kelvin's instruments were for general use. One small part of his labors in this field (though small only in comparison with the greatness of his life's work) was the devising of instruments for practical electrical measurements. The student to-day who has at hand a large assortment of instruments can not understand the difficulties under which his predecessors worked, and he would probably make little progress if he were required to make all measurements by means of a galvanometer. It was Kelvin who devised a variety of electrical meters intended for every-day use, and although these have to-day been superseded by others more convenient, they showed the way.

In the broader field of electrical application he has also left his mark. Thomson's law for the economical section of copper for a transmission system states a fundamental engineering principle, although to-day other reasons may intervene to prevent us from adopting that design which would in the end cost the least.

Although the electrical branch of engineering owes more to him than to any other single worker, it is probable that his fame in years to come will depend more largely upon his purely scientific work. And it is remarkable that up to the very last he was able to take energetic part in the discussion of the new theories which promise so much. Nor was his stand that of a captious critic, but of one who realized the importance and value of the new ideas, but who also could see the weaker points and who, by pointing them out, stimulated others to still greater efforts; and no one had better right to do this, as none had devoted more thought to the structure of the atom.

Of his personal character much might be said. He had that kindly spirit which was quick to sympathize with others, and although ever ready to maintain his own opinions, he was always considerate of those of his opponents. It was of him that the great Huxley said, referring to one of his brilliant controversies, "Gentler knight never broke lance."

We have at last lost one we can ill afford to spare, but we should rejoice that he was with us so long and was able to contribute so largely to the welfare of the world. His name will ever stand as one of the greatest of the sons of the world.

LONG-DISTANCE WIRELESS TELEPHONY.

The establishment of wireless telegraphic communications has hardly ceased to be a matter of comment for technical and daily press. A few journals of the former class, it is true, criticize the statement that a working wireless system has been put into service, but these critics are, perhaps, too exacting in their demands; for although the service now given does not pretend to compete with that given by the many submarine cables, and is, perhaps, limited in its availability, still, certain of the daily papers, in this country at least, are reporting a considerable amount of news by the new method. With the situation standing thus it seems rather daring for one of the more successful workers in the field of wireless telephony to announce publicly that he purposes establishing a transatlantic system the coming month of February. Yet this is the report that has been published as emanating from Vladimir Poulsen, the distinguished inventor of the telegraphone.

That transatlantic telephony is a possibility many will contend. Yet the prospects of putting such a service into operation within three months seem small to those who are not personally familiar with every step that has been made, and can only judge from the results which have been made public. Moreover, the efforts required to establish transatlantic communication, both by means of cable and wireless, were extended over a number of years, and up to the present time the long distances over which our telephonic communications have been obtained without wires is something less than 300 miles, and this was only experimental. To jump at once from this comparatively short distance to that required to span the Atlantic seems a greater feat than can be expected to be accomplished in three months. There are, moreover, a number of features of wireless telephony which put it at a disadvantage as compared with wireless telegraphy. The first and most serious of these is the amount of energy available at the receiving station for actuating the telephone instrument. In wireless telegraphy but a small amount of the energy radiated from the transmitting station reaches the receiving station, but nearly all of that which can be caught there is available for producing signals. On the other hand, the telephonic signals are reproduced merely by the variations in the received energy. Assuming that the telephonic system can radiate as energetically as the telegraphic system, the former transmits its signals by varying the rate of emission, and it is these variations of the energy which represent the signals and not the energy itself. At the receiving station the signals must be produced by the corresponding variations in the energy collected by the antenna. Obviously these variations must be considerably less effective in actuating a receiving device than the entire energy collected. It is thus evident that the transmitting end of the wireless-telephone system is at a considerable disadvantage as compared with the wireless-telegraph system, for the latter may utilize any method of radiating energy, however powerful, which is suitable for the telephone, and the whole must be more effective than a part.

At the receiving end the conditions are no more favorable to the telephone system than the telegraph, for although the telephone receiver is a fairly sensitive instrument, it may be, and often is, employed for detecting the clicks representing the telegraphic message as well as for reproducing spoken words, and it would seem that it should be more sensitive to the former effect,

irrespective of the greater amount of energy available, than for the latter, as a click could be detected and recognized when words would be unintelligible. The conclusion may therefore be drawn that whatever distances may be covered by the wireless telephone system may be still more satisfactorily covered by employing the same arrangement for telegraphy the transmitting key in this case taking the place of the transmitting telephone instrument. And, conversely, it may be expected that telegraphic communications over long distances will, for some time at least, be considerably more effective than telephonic; and since transatlantic communication by the latter method is still slow, obviously, great care is necessary in sending and receiving messages across the Atlantic by means of this method, and it seems hardly probable that wireless telephony will be established across the ocean within the time specified.

In considering this proposed transatlantic system there is an interesting problem which has already been mentioned in connection with transatlantic submarine telephony, but which seems more difficult in connection with a wireless system. It is this: If the telephone system is to be established, will transmitting and receiving stations be placed in the large cities, say London and New York, or will the inventor take advantage of the reduced distances of transmission and better route, if the expression may be used, obtained by establishing points of communication on the coasts of Ireland and Newfoundland? Certainly the prospects of establishing communication would be better at these points. Yet such a system could only be experimental, as it is hardly likely that it could be operated satisfactorily by connecting through to overland-lines stations at the large cities, as communication over such lines is still wanting. But assuming that these land lines could be used and operated satisfactorily, it seems improbable that the weak messages received overland could be satisfactory for operating the wireless system. To get around this difficulty the operators at the two wireless stations might interpose between the wireless and the wire systems, but when this is done, what we have is not exactly what one thinks of when he speaks of telephonic communication. The conclusion seems unavoidable that long-distance wireless telephony, such as has been proposed, can be but experimental at this time.

The difference in time between the two sides of the ocean is also to be considered. Messages might, of course, be taken down and handed to the persons for whom they are intended later on when the latter can not be reached at the time of the call. But such an arrangement converts the telephone system into an equivalent telegraphic system, so that nothing would be gained, with the possible exception that if by any means satisfactory telephonic communication can be established this method might be more rapid than the present telegraphic system. The operator might take a spoken message down in short-hand for later copying and transmission and thus increase the rate of transmitting messages.

THE EFFECT OF FROSTING ON INCANDESCENT LAMPS.

In the ELECTRICAL REVIEW for April 6 there was a communication from Dr. Edward P. Hyde, discussing the effect of frosting the bulbs of incandescent lamps. It is well known that such lamps have shorter useful lives than the clear-bulb lamps, and since it is also well known that the frosted lamps themselves become hotter, which is usually an indication of lower efficiency, the conclusion was jumped at that frosting the bulbs in some way affects the filament so as to shorten its serviceable life. There seemed to be no very good reason for this and Dr. Hyde, upon investigating the matter, concluded that the assumption was unsound, and that the effect was not due to an actual change in the filament itself, but to other conditions which are affected by frosting. When a lamp has been burned for some time the inner surface of the bulb becomes slightly blackened, due to the deposit of carbon upon it. With the clear bulb nearly all the light passes directly out through the glass and thus passes through this deposit but once. There is some reflection from the surface of the glass, but this is probably slight. With the frosted bulb, however, considerably more of the light is thrown back into the bulb, and it thus passes through the carbon deposit a second time and yet a third time when passing out through the opposite side of the bulb. The absorption due to the deposit is then at least three times that of the clear-bulb lamp. And the same effect takes place again when even the reflected ray endeavors to pass out, part of it being again thrown back. Dr. Hyde believes that it is this repeated passage through the carbon deposit which decreases the useful life of the lamps and that the actual life of each filament before burning out is the same. Indeed, the increase in the temperature of the bulb due to frosting is too slight, when compared with high temperature of the filament itself, to have any effect.

Dr. Hyde has gone into this matter still further, and in the December issue of the "Bulletin of the Bureau of Standards," in conjunction with Mr. F. E. Cady, contributes the result of their further study. These entirely agree with the previous report on the effects of frosting.

The authors designate the effect of frosting in decreasing the amount of light, as the "change in absorption," since, of course, clear-glass bulbs do absorb some of the light energy. They find that this change in absorption is about six per cent for seasoned lamps.

One of the other effects of frosting is the change in the spherical reduction factor; this is, the factor that gives the ratio of the mean spherical candle-power to the mean horizontal candle-power. Frosting the lamp is usually supposed to widen the distribution and make it more uniform, and should therefore increase the reduction factor, making it nearer unity. It was found that this rule did not hold, for in certain of the lamps the spherical reduction factor was actually diminished, and in others the change was very small.

The shape of the bulb is an important factor in this matter and suggests that there may be some best shape of bulb, not only for frosted but for clear glass as well. The question of size is also important for, as is pointed out, by doubling the surface of the bulb a much longer serviceable life would be obtained.

SUCCESS OF THE HERMITE ELECTROLYTIC SANITATION AT POPLAR, ENGLAND.

[*By Our London Correspondent.*]

The important electrical sanitation experiment which was started by the Poplar Public Health Committee in February, 1906, at the instigation of Dr. F. W. Alexander, is again receiving a certain amount of attention by reason of the publication of a statement showing the cost of operation, etc., down to October 1, 1907. The cost of producing the electrolytic disinfectant at Poplar was the subject of a good deal of inquiry not long ago, and Dr. Alexander, in a communication to one of the leading London medical journals, stated that his experience, obtained with constant working, showed that the Hermite apparatus, if properly managed, worked under fifteen amperes at 240 volts, which made the cost of electricity forty-two cents per eight hours at a flat rate of three cents a kilowatt-hour. The salt for every charge of 185 gallons was a fraction over twenty cents, at $6 a ton, and magnesium chloride for every charge was a fraction over sixteen cents, at $16.52 a ton, and the chemical for rendering the oxygenated compound stable, fourteen cents, so that the total amount might be stated at $1.54 per 185 gallons at four grammes of available chlorine per litre.

The total cost of the depot, plant, fittings, testing apparatus, carboys, siphons, etc., has been $2,900 odd. Between February, 1906, and October, 1907 (twenty months), 27,320 gallons of disinfecting fluid of an average strength of 4.5 grammes of chlorine per litre (4.5 per 1,000) were manufactured and supplied as follows:

Twelve thousand three hundred and one gallons (two cents per gallon) to the works department for watering roads, flushing gullies, sewer manholes and market places; 996 gallons delivered gratis to workhouse and other guardians' institutions; 434 gallons delivered gratis to managers of sick asylums; 13,589 gallons distributed to the public from the four depots, including also fluid supplied to Poplar and Bow Baths.

The total cost of producing and delivering the fluid for the period named was $4,280, and Dr. Alexander in his report shows that if carbolic-acid disinfectants had been used in place of electrolytic fluid the cost would have been $8,050. There is thus a saving to the borough of $3,770 for the period. The plant is stated to be still in good working order, turning out 185 gallons of fluid in eight hours at the average strength already mentioned. It has not been necessary to renew any of the zinc electrodes, which from their present condition are expected to be capable of use for a further period of twenty months or longer.

It may be remembered that about a year ago C. V. Biggs read a paper before the London Faraday Society on the Poplar plant, from the working of which he drew the following conclusions:

(*a*) The manufacture of hypochlorite solutions can be carried on by a process which is practically automatic.

(*b*) For an output of 200 gallons per eight hours at four grammes per litre the capital cost, including buildings and fittings, should not exceed $2,500.

(*c*) Where continuous current is available the series system of electrolyzing is the most suitable. Where alternating current only is to be had, and a motor generator must be installed, fewer cells may be employed. In the Poplar plant about one gramme per litre is added for every ten cells.

(*d*) That a warm climate would not affect the manufacture at any rate of magnesium hypochlorite.

For the benefit of readers who may not already be familiar with the details of the Poplar experiment we make the following extracts from a report issued by Dr. Alexander:

The system adopted at Poplar is to mix a certain quantity of fluid in an elevated tank and then to allow this fluid to flow through four double troughs, or cells, placed one above the other, so that the liquid descends continuously by gravity. Each trough is divided laterally by a partition, and in each of the two divisions five distinct "elements" (consisting of one positive and two negative plates) are suspended. The positive plates are of thin platinum wire wound upon slate slabs, and the negative plates are of zinc. There are thus four troughs, each containing ten "elements," or forty cells in all. The liquid enters through a funnel at the top, passes along the front division of the top trough, back through the division behind, over a weir and into a subdivision, from which it is drawn off by the bent glass tube discharging into the second funnel; it passes along the front division, back through the division behind, over the weir into the pocket of the second trough, and so on to the final bent tube, which discharges it into a carboy. As the liquid passes through the troughs it is subjected to the action of a regulated current of fifteen to seventeen amperes at 230 to 250 volts, being 5.7 to 6.2 volts per cell. During the run the liquid in the carboy is thoroughly stirred by means of an ebonite rod provided with rubber flaps.

The objects aimed at to make the working of the apparatus and the manufacture of the fluid become simple and automatic were as follows: (1) To see at a glance whether the apparatus is working properly. This is accomplished by a gauge glass in front of the large tank and another gauge glass on the little supply tank, the first to show the quantity of salt liquor capable of being acted upon, and the second to show if the liquor is running properly into and out of the small supply tank, as the chloride of magnesium contains impurities which are likely to block up the valve of the small cistern and the taps leading to and from the same. A thermometer is kept in the small supply tank to see the temperature of the salt liquor, and another thermometer is placed at the outgo of the electrolyzer; the difference of the temperature gives the rise in temperature due to the electrolysis, and which is found, when the apparatus is working satisfactorily, to be under thirty degrees Fahrenheit. The small tank is necessary to keep a constant flow of the fluid into the electrolyzer. When first the apparatus was erected the fluid used to become unduly hot on account of the flow slowing down through the diminution of the head of water in the large tank. The tank had ultimately to be raised on to girders, and a small supply tank fixed at a lower level. (2) The liquor to be electrolyzed in the large tank had to be stirred from time to time to keep the mixture of an equal gravity throughout, more especially as for obvious reasons a certain quantity of a solution of sodium hydroxide is added. To keep the liquor stirred a large broad drilled plate of galvanized iron is used, one end of which acts as the fulcrum when the other is lifted up by means of a chain leading over pulleys to the ground, so that the attendant has only now and again to pull the chain to lift the plate up and down instead of running up and down a ladder and stirring the liquid with a rod. (3) It is necessary to govern the electric current, which is taken direct from the mains, on account of the density of the salt mixture to be acted upon varying from time to time owing to temperature changes and consequent changes in conductivity. This difficulty is got over by a current regulator. (4) To prevent shocks and waste of fluid while changing the carboys, a special glass tap has been made. (6) So far as oxychlorides are concerned, the apparatus in ten months had only been taken to pieces and cleaned twice. Every day, after working, the electrolyzers are emptied by means of the mud holes by removing the rubber plugs, and the fluid which is run out is kept to recharge the electrolyzers. The electrolyzers, after being emptied, are washed out by means of a hose, and then until the next working are kept filled with water, which softens any deposit formed upon the electrodes, and before starting work the electrolyzers are emptied and washed out again, a matter which takes up a few minutes every day before and after each working.

A. H. Bridge.

London, December 16.

The semi-annual meeting of the Missouri Electrical Contractors' Association was held in St. Louis on Thursday, December 12. The members were the guests of the Jovian Club at noon at the Planters' Hotel. A smoker was given in the evening.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

GAS ENGINES AT COLLIERIES.

I think I have before mentioned in these notes that gas engines are likely to take an important position in the working of collieries. I think I mentioned a case that I had through my hands a little time ago, where an electrical coal-cutting plant had to be shipped to some collieries in a very cold district, and we employed suction gas producers and gas engines to drive the electrical plant, because the difference in running costs between that and steam was very great. There are signs of steady development in the use of gas engines at collieries, fed by suction gas producers, by gas from coke ovens, and from blast-furnaces. A friend of mine, the manager of some large collieries in South Wales, writes me that he is putting down a suction gas plant to drive an electrical power station. For some years, also, coke-oven gas has been employed in some of the Yorkshire collieries for driving gas engines on the surface, and at the pit bottoms for working mine-rope haulage, and the manager of one of the collieries boasted that he was working more cheaply than any electrical power station could supply him. I think he is now arranging to use his gas engines to drive electrical generators, with the view of distributing by electricity. The latest development in this direction is the installation by the Powell Duffryn Company, of South Wales, of a 1,200-brake-horse-power Nürnberg gas engine, arranged to drive a three-phase alternator, for the power work of the colliery. The engine is fed by coke-oven gas, whose calorific value is given as from 350 to 400 British thermal units. The average calorific value of coke-oven gas may be taken at 400 British thermal units, as against 650 for ordinary town's gas, and from 120 to 200 for producer gas. I understand that a second Nürnberg gas engine of 2,400 brake-horse-power is to be put down at the same colliery, at Bargoed, in the Rhymney Valley. The Bargoed pits are the new sinkings put down by the Powell Duffryn Company, and it will be interesting to watch the development of the power station at Bargoed, worked by coke-oven gas, as against that at Aberaman, belonging to the same company, worked by steam. The running costs at Aberaman were given at 0.375 penny per unit.

ANOTHER USE FOR ELECTRIC MOTORS UNDERGROUND.

The great convenience of the electric motor renders it particularly suitable for the running of machinery in mines, particularly where the apparatus may have to be rigged up upon a temporary framework and moved about from place to place, or may have to be portable. The latest opening for the electric motor is in driving vacuum apparatus for collecting the coal dust that is deposited about the roadways, etc., of coal mines. The dust that is made and collects in the roadways of a coal mine constitutes one of its greatest dangers in case of an explosion. Explosions have even been caused by the presence of coal dust alone, without any explosive gaseous mixture. All that is necessary, in fact, appears to be some heating agent, such as a blown-out shot, that is the most frequent source of the trouble, but the short-circuit between cables, followed by an arc, would be equally as dangerous. In either case, if a sufficient quantity of the coal dust is ignited, the heat generated by its combustion leads to a further rapid combustion and to the raising of a cloud of the dust along the roadways of the mine, this being followed by further combustion at an increasingly rapid rate, and finally by all the phenomena we understand by the term explosion, *viz.*: the rapid production of a volume of gases heated to a very high temperature within a confined space. In some coal mines dust is made very largely. The mine wagons, as they are drawn from the working face to the shaft, are subject to a good deal of jolting, and this produces a good deal of friction between the lumps of coal packed in the wagons, the result being the production of a large quantity of dust. In addition to this, dust is produced in various other ways, and it may be found in all of what are known as dusty mines, comprising a very large proportion of coal mines, forming a carpet on the roads, and also a crust upon the mine props, and in interstices in the roof and sides, and so on. When an explosion takes place all this dust is discovered, so to speak, is brought out of its hiding places, and adds to the force of the explosion wave. Mine managers have been instructed for a long time to water their roads but, as so often happens, watering leads to other troubles. It leads to falls of roof, to rotting timber, and to other and very serious troubles which are constantly present, while explosions, even at their worst, are only occasional. A Royal Commission has been sitting for some time investigating the causes of loss of life in mines, and among other things the question of coal dust has come up; and at one of the sittings of the commission George Fowler, an eminent mining engineer of Nottingham, suggested that a very efficient method of dealing with coal dust would be the adoption of the probably well-known system on your side of the Atlantic —of the vacuum cleaner. The vacuum cleaner, it will be remembered, consists of a tube, with a mouthpiece of some kind, which is connected to an engine arranged to produce more or less of a vacuum, that is to say, to produce a pressure inside of the tube considerably lower than that of the atmosphere. When the mouthpiece of the tube is carried about over the surfaces of furniture, carpets, sofas, etc., it extracts the dust and all small matters that are usually extracted by the process of beating, and delivers them into a receptacle provided for it before the tube reaches the engine. Mr. Fowler suggested that a similar arrangement could be mounted upon a mine wagon, run along the mine roads, and be directed to every part of every road —the roof, the crannies mentioned, the pit props, the roads, and so on, and that in this manner the whole of the dust could be removed at a moderate cost and the danger from coal dust eliminated. The suggestion has been taken up by the manager of the Whitwood Collieries, in Yorkshire, the collieries where, by the way, they have been using coke-oven gas for some years, as mentioned above, and where running costs are so low; and an apparatus has been arranged, consisting of a vacuum engine, driven by an electric motor, the two being mounted on a trolley, with a receptacle for the dust—the trolley being arranged to run on the ordinary mine rails. In the apparatus referred to a five-horse-power motor is employed, and the vacuum engine is fitted with several flexible hose, ending in nozzles, which are directed to different parts of the roadway at the same time, the floor, the roof, the pit props, and so on. The apparatus is pushed along the roadway by hand and takes its current from the electrical power service of the colliery. The dust is removed from the collectors as fast as they are filled, into buckets, which are carried out of the mine. I understand that a similar apparatus has been fixed at the Courrières mines, where the disastrous explosion took place a few years ago in France.

NEW ELECTRICITY SPECIAL RULES.

A few months ago the Home Office issued some special rules controlling the use of electricity in those parts of coal mines which come under the Factory act, and they are giving mine managers a considerable amount of anxious thought. It

will be remembered that it is only a very short while since the Home Office was supposed to have thrashed out the whole matter of the use of electricity in coal mines, and to have issued a number of rules for the guidance of colliery managers, but it appears that the Home Office has a factory department, and a part of a mine may be a factory, in the eye of the law, and therefore come under factory legislation, and consequently these new rules which have been got out by the Home Office to apply to the use of electricity in factories generally have also been thrown at the mine managers' heads. The two sets of rules are necessarily likely to cause confusion, and meanwhile the working of the first set of rules is by no means all plain sailing. Thus, a case occurred a short while ago where a man was killed in a Scotch colliery by receiving a shock from a coal-cutting machine. The insulation of the flexible cable leading from the gate-road switch-box to the machine had been worn through, and so the conductor itself made contact with the frame of the machine, and when one of the men touched the machine in the course of his work he received a shock and was killed. Two or three questions arose in connection with this matter, which show the difficulties that are likely to arise, particularly where lawyers are set to administer in cases of this kind, without an assessor. One question that arose was as to having a competent electrician present. What constituted a competent electrician? and, How near must he be to every apparatus? If it was necessary that a competent electrician should be within easy reach of every electrical apparatus in a large mine, the cost would be very great. On the other hand, could it be said that the rule requiring that a competent man should be present was fulfilled when a competent electrician was kept at the mine? The other point that arose, and which illustrates what I have mentioned above about the difficulty of a lawyer judging a case of the kind, arose out of the question of the insulation of the flexible cable having been destroyed. The flexible cable was insulated in the usual way and, in addition, it was run through an india-rubber tube, and the india-rubber tube passed right through the hole in the casting of the machine, through which the conductor was carried to its terminal. In the ordinary course of work, both the rubber tube and the covering of the conductor were worn through and connection was made, as explained, between the conductor and the frame of the machine. The judge who tried the case struggled with the problem. It was claimed on behalf of the Home Office that the hole through which the flexible conductor passed, in the frame of the machine, should have been bushed. On behalf of the makers of the machine it was claimed that the india-rubber tube was equivalent to a bush, but the judge held that by no possibility could a tube become a bush. He held that the tube was a tube, outside of the hole that was to be bushed, and that it could not on any account change its nature by merely entering a hole. No one appears to have been able to explain to the judge that a bush is also a tube, and that the tube, provided it was a good tube, and provided that it stood wear, was not only a very efficient substitute for a bush, but probably a much better method of dealing with the problem. The colliery manager who was on trial at the instance of the Home Office in the matter was acquitted on all counts except this, and on that count he was sentenced to a small fine. The judgment may be good law, but it strikes the average Englishman as not exactly common sense.

Lord Kelvin Buried in Westminster Abbey.

At noon on Monday, December 23, England paid her last great tribute to a great man, and Lord Kelvin was buried at Westminster Abbey in London. His grave is at the foot of the statue of Sir Isaac Newton and close to the grave of Charles Darwin.

The coffin arrived from Scotland early Sunday morning and was placed in St. Faith's Chapel, where a short memorial service was held. The inscription on the coffin ran:

"William Thomson, Baron Kelvin of Largs, P. C., O. M., G. C. V. O., F. R. S., LL.D., D. C. L. Born June 26, 1824, Died December 17, 1907."

Rarely has such a remarkable assembly of scientists and persons of distinction been gathered within Westminster Abbey. Representatives of the various universities were there, wearing their academic robes. Representatives of foreign scientific bodies wore their decorations. Outside the Abbey stood a large gathering of the public.

As the mourners assembled within, Purcell's and Chopin's funeral marches were played. At noon the coffin was borne in procession through the cloisters, the choir singing. Twelve of the Abbey clergy were in the procession. The dean of Westminster, assisted by Canon Duckworth, officiated. The pallbearers were Lord Rayleigh, Admiral Sir E. H. Seymour, John Morley, Gaston d'Arboux, secretary of the Academy of Sciences of France; Sir Archibald Geikie, president of the Geological Society; Lord Strathcona, Professor Crum Brown, of the Royal Society, Edinburgh; Professor Sir George Darwin, University of Cambridge, master of Peterhouse College, Kelvin's old college; Dr. Macalister, principal of the University of Glasgow; Sir J. Wolfe Barry of the Institute of Civil Engineers, and R. T. Glazebrook of the Institute of Civil Engineers.

The Duke of Argyll represented the King. The Prince of Wales and the Duke of Connaught were also represented. Of the innumerable wreaths and other floral pieces only three were placed on the coffin: a cross from Lady Kelvin, a wreath from the Royal Society and a bunch of flowers inscribed "A. and M."

A delegation from Glasgow University included Sir W. Bilsland, vice-chancellor of the university and the Bedellus of the university, bearing the mace, draped.

Cambridge was represented by Vice-Chancellor Sir John Gavey, Sir Henry C. Mance and W. H. Preece. Alexander Siemens and other past presidents of the Institute of Civil Engineering were present. Sylvanus P. Thompson represented the Italian Electrical Association and H. F. Parshall and Joseph Wetzler the American Institute of Electrical Engineers.

Secretary John Ridgeley Carter represented Ambassador Reid. The Russian and Italian ambassadors were present in person. The German and Japanese ambassadors were represented.

The Princess Louise, Lords Tweedmouth, Kinnard, Cecil and Manners, Sir John Bell, Lord Mayor of London, and Sir W. Crookes were present, together with representatives of the scientific societies of all the European capitals and of the big British engineering firms.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on January 14, for the following electrical supplies: One truck light controller, one eight-kilowatt generating set, one switchboard for two eight-kilowatt generating sets, and two Navy Standard truck lights for delivery at Boston, Mass.; one eight-kilowatt generating set for delivery at Norfolk, Va.

Professor D. A. Lyon, of the geology and mining department of Leland Stanford University, Palo Alto, Cal., has been granted a leave of absence of six months to complete experiments upon a new electric smelter in the mines in Shasta county.

REFRIGERATION AND POWER-PLANT PRACTICE.

BY JOSEPH H. HART.

The fact that mechanical refrigeration is more or less connected with the production of power is a matter of common knowledge to the average engineer, but the statement that mechanical refrigeration may become closely connected in its development to that of large power units in cases where power production is now the sole object, will prove a matter of considerable surprise to the greater number of engineers. That this is undoubtedly a fact is becoming more and more evident daily and the inter-relations between the two are steadily becoming more and more complicated in their nature and more dependent upon the services of an engineer thoroughly familiar with both departments.

That power production should be dependent for its best efficiency upon the production of refrigeration as a by-product, is a matter of recent development, and dependent in this connection upon the recent development in refrigerating engineering itself. In order to illustrate the relation of the two developments in this field, an explanation of the present status of mechanical refrigeration is necessary with its limitations and possibilities, and a further statement in regard to the present relationship between the two is also required. The fact is that both power production and refrigeration production, in their large and most efficient developments to-day, possess certain limitations which are almost eliminated when operated together. Thus, an efficiency may result in a combination plant used for the production of both power or refrigeration such as has never before been obtained.

In order to see this clearly we will first take up the limitations of the existing power plant as utilized in the modern development. In large units large compound-condensing engines are used with superheaters and steam jackets, and every attempt is made to get the last ounce of power out of the steam at its best efficiency. That this development may have exceeded its efficient stage is a matter for consideration. Undoubtedly in some cases the first cost and cost of maintenance and depreciation factor which exist in many of the accessories for saving steam and increasing the efficiency of power production in this process would become inefficient if a more suitable way of using steam should ever arise again. In the consumption of power the trolley and lighting systems throughout the country are undoubtedly the most important factors, and each of these possesses certain limitations in its consumption of power which limit the efficiency of the plant. Of course the great majority of these plants utilize their power in the production of electricity, and it is utilized in this form. This further complicates the matter of increasing the limitations; although it also eliminates many others formerly existing. Thus, both trolley and lighting systems operate with variable loads, that is, the consumption of power is of variable amount, due to present conditions of operation. The chief load of the trolley system comes in the morning and evening, before and after business hours, and the same can be said of the lighting system where electricity is used. Formerly it was customary to install a power plant of sufficient capacity for the average load throughout the day. When the power consumption was light, the excess power was turned into storage batteries, which became available for increasing the output at times when the load was excessive. The cost of installation of the batteries in these storage systems was such, however, that it was found preferable rather to install sufficiently large plants to take care of the maximum load continuously. Thus, it meant that the plant in ordinary operation operated at diminished capacity, and hence at diminished efficiency. This method, however, proved more efficient than the storage-battery system, but was, however, simply the choice of the lesser of two evils. This latter condition of affairs has resulted in a supply of power, often intermittent, available for outside consumption and used to-day by many small power consumers limited by the nature of its production. This power must necessarily be intermittent, and, therefore, inefficient. Many central stations have sold power for continuous consumption in small units where such power was in reality not available, with the hope that they could get along somehow or other. The ideal consumption, however, in this local field is an absolutely intermittent power consumption. That refrigeration supplied this field is to-day a matter of common knowledge. The limitations of the two systems, under certain conditions, can be made identical or rather corollary. Refrigeration plants supply a perfect substitute for the ideal storage battery in at least one of its functions.

This fact has been recognized by small consumers of power for refrigerating purposes and they have availed themselves of this condition, and the consequent low price of intermittent power, to such an extent that the power has been sold to small refrigerating plants in fairly large quantities, and this development is recognized by central stations as a regular definite consumption.

Undoubtedly this situation of intermittent power for sale in large power plants has resulted in a remarkable development of small refrigerating plants which would not otherwise have occurred. These small refrigerating plants utilize the compression system of ammonia refrigeration almost without exception and have aided the development of the latter system to an extent that is not warranted by its own efficiency. Thus, in refrigeration, there had existed only normal influences at work for the best efficiency before various outside effects have added their influence. The development in refrigeration, however, within the last decade has been such as to modify materially the present status of mechanical refrigeration and its relation to the normal production of power. Thus there are in existence to-day two different types of refrigerating machines which are much superior to any of the other types on the market. Both of these utilize ammonia as a refrigerating agent, and this latter substance is generally recognized as the most efficient agent for the conveyance of heat in refrigeration, and occupies a position analogous to water in power production.

Very many fluids have been used at various times for refrigerating purposes, but ammonia is now undoubtedly recognized as the best. The two developments which utilize ammonia as a refrigerating agent are known as the compression and absorption types, respectively.

Refrigeration in both cases is produced automatically by the boiling away of the ammonia liquid and the consequent absorption from the remainder of the latent heat of vaporization required to accomplish this. Liquid ammonia is volatile and boils away under ordinary pressure at a temperature much below zero Fahrenheit. Thus, the object of the machinery in refrigeration is simply the reproduction of the refrigerating fluid after its utilization. The compression type uses a compressor to compress the residual ammonia gas to a pressure sufficient to permit condensation at ordinary temperatures. The absorption type utilizes the absorptive power of water for ammonia gas, and the loss of this power with rise in temperature to produce the same result. The compression type requires a compressor operated by some form of power.

The absorption machine utilizes the heat in steam and drives off the gas from aqua ammonia under pressure sufficient to permit condensation. Thus, in reality, the compression machine uses the work available in steam, whereas the absorption type utilizes the heat available in steam. Undoubtedly, the absorption-type machine utilizes in its best operation more heat than the compression type, and when the quantities of steam taken from the boiler are considered, the absorption type is much superior. Thus, it is now recognized in plants of 100 tons capacity per day or over that the efficiency runs about as follows: The compression plant generally operates on an eight-to-one basis, that is, eight tons of ice can be produced to every ton of coal consumed. The absorption plant of the same capacity can generally operate on an eleven-to-one basis, whereas the combination plant of the compression and absorption types, the exhaust steam from the compression plant operating the absorption system, can operate on a fourteen-to-one basis. These figures merely represent an average, with a possibility of almost fifty per cent variation in either direction, dependent absolutely upon the efficiency of operation of the plant. The utilization of exhaust steam represents the advantage of the absorption system to-day. The production of power is an expensive process and a very inefficient one. Very little of the heat actually put into the steam in any case is ever transformed into work. This steam was formerly used for heating and for drying purposes in some isolated cases. The use of condensing engines increased the ratio of useful heat to total heat consumption but slightly. The absorption system can utilize the residual heat in steam after power production very efficiently in competition with a plant which utilizes the power directly.

The reason that the absorption system is not in more general operation to-day is the fact that formerly it was extremely inefficient. Absolutely none of the physical constants of aqua ammonia and the vapor pressures and temperatures of a mixture of steam and ammonia gas were known, and hence all designs of machinery dependent upon these were constructed on the hit-and-miss principle. The non-removal of water vapor from the ammonia gas or condensation of the latter results in the elimination of the device as a refrigerating machine, and practically no refrigeration is produced. The efficiency of both types of refrigeration machines is dependent almost absolutely upon the design and the method of operation. Formerly the construction of the generators and absorbers of the absorption type was such that steam under considerable pressure was required for their operation. To-day, however, practically exhaust steam can be used in their operation, and in this development it does not pay to use high-pressure steam, since the possible amount of heat in steam increases but slowly with a rise in pressure, and this latter quantity is the only important factor in the absorption type of refrigerating machines.

Thus, we come to these rather anomalous conditions. The large power plant utilizes the work available in steam and wastes the heat remaining, or at least utilizes it inefficiently. Large absorption type refrigerating machines utilize the heat only in the steam, and hence utilize the heat transformable into power very inefficiently. Thus, a large power plant which turns its exhaust steam into an absorption refrigerating plant utilizes both developments at their best efficiency. The absorption machine utilizes large quantities of exhaust steam and the exact situation of the compound-condensing engine in a central station of this type would be a matter of considerable thought. The condensing feature must undoubtedly be eliminated for utilization of steam in an absorption plant, and there is small doubt that the cheapest slide-valve engine production would prove very satisfactory in a development of this type. A large number of absorption plants in existence to-day are wasting the power available in the steam consumed by them. Many of these have utilized the power to a greater or less extent in the operation of their own lighting systems, in competition with ordinary sources of supply, and undoubtedly the movement will extend much further. While the possibility of operating a large cold storage plant, with large quantities of power for sale as a by-product, seems rather impracticable at the present day, it is by no means an impossibility.

This development, as represented by the utilization of the exhaust steam from a power plant in an absorption system, is not the only connection between these two departments. Many power plants, in preference to selling their intermittent power to small power consumers, have utilized the same in the operation of a cold-storage plant, and use the compression type operated in conjunction with the power plant. Such companies have an additional source of revenue, which is often extremely profitable, but the intermittence of the power in these cases is absolute. The complete shut-down of the refrigerating machinery has no effect on the refrigeration product. The procedure in these cases consists in the cooling of large quantities of brine at extreme temperatures during the operation and the carrying of the plant by means of this cold brine for an indefinite period. Thus the brine-tank in reality takes the place of the storage-batteries in the storage of excess energy. Further, the problem is complicated by the fact that many refrigerating plants operate on a compound system, as has been said, the power and heat being used at its best efficiency in a combination plant. The exact position of these two departments in regard to power production is uncertain, and only time and experiment can really develop their exact status.

Shrinkage of Wood When Dried.

Interesting experiments on the shrinkage of wood due to the loss of moisture have recently been completed by the Forest Service at its timber-testing station at Yale University. These experiments show that green wood does not shrink at all in drying until the amount of moisture in it has been reduced to about one-third of the dry weight of the wood. From this point on to the absolutely dry condition, the shrinkage in the area of cross-section of the wood is directly proportional to the amount of moisture removed.

The shrinkage of wood in a direction parallel to the grain is very small; so small in comparison with the shrinkage at right angles to the grain, that in computing the total shrinkage in volume, the longitudinal shrinkage may be neglected entirely.

The volumetric shrinkage varies with different woods, being about twenty-six per cent of the dry volume for the species of eucalyptus known as blue gum, and only about seven per cent for red cedar. For hickory, the shrinkage is about twenty per cent of the dry volume, and for long-leaf pine about fifteen per cent.

In the usual air-dry condition from twelve to fifteen per cent of moisture still remains in the wood, so that the shrinkage from the green condition to the air-dry condition is only a trifle over half of that from the green to the absolutely dry state.

Transfer to Membership in the American Institute of Electrical Engineers.

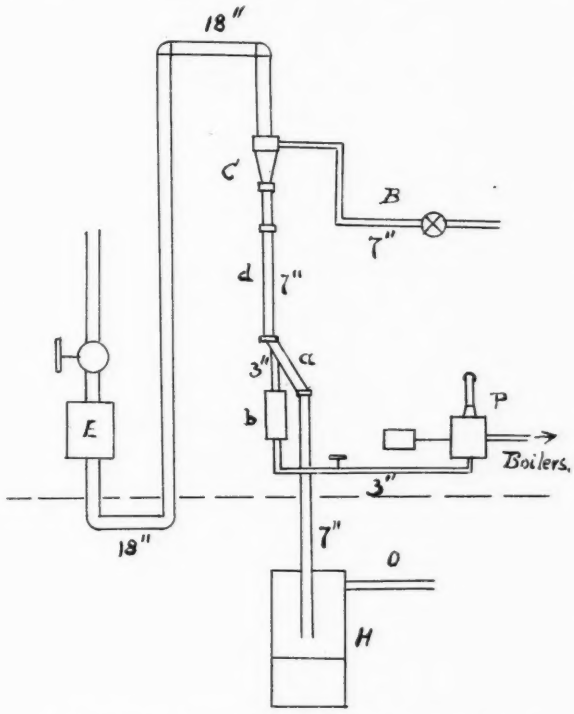
At a recent meeting of the board of directors of the American Institute of Electrical Engineers the following associates were transferred to the grade of membership: James William Fraser, Arthur W. Henshaw, George Eugene Wells, George Hillman Whitfield, Fay Woodmansee, William Corin and Van Rensselaer Lansingh.

A METHOD OF FEEDING BOILERS WITH CONDENSATION WATER.

BY H. S. KNOWLTON.

A simple but exceedingly effective method of feeding steam boilers with condensation water from reciprocating engines has been devised and patented recently by William H. Coughlin, superintendent of the Worcester (Mass.) Electric Light Company. The accompanying diagram shows the arrangement of apparatus, four of these outfits having been installed at the Worcester plant. C is a barometric jet condenser connected with the eighteen-inch exhaust pipe E in the usual manner with a seven-inch cold-water injection supply pipe B introduced into the condenser head. The seven-inch discharge pipe *d* is carried to the hot-well H as usual, O being the hot-well overflow.

The special feature of the arrangement is a lateral off-set inclined section *a* in the main discharge pipe. Connected with this is a sink pocket or chamber *b*, about three feet long, which is considerably larger in cross-section than the three-inch pipe which connects the pocket with the inclined section, and which leads from the pocket to the boiler-feed pump P. The engine is a twenty by fifty-two by forty-eight-inch horizontal cross-compound unit. The operation of the arrangement is as follows: The exhaust steam from the engine is condensed in the usual manner at C, and the discharge, which is oily and greasy, is passed down through the pipe *d*, most of it going to the hot-well and thence out by the overflow. Some of the discharge, however, is deflected into the pocket *b*, where it has time to settle. The oil rises to the top of the chamber and is gradually carried away by the passage of the condensation along the pipe *d* to the hot-well. The water in the pocket settles to the bottom and is pumped to the boiler-feed lines at a temperature of about 190 degrees Fahrenheit. A saving of about $2,400 in the fuel bill this year is expected at the Worcester plant by this apparatus, which costs nothing to operate and which can be installed at nominal expense. This is about six per cent of the total fuel expense of the company.



A METHOD OF FEEDING BOILERS WITH CONDENSATION.

A New Mercury Interrupter for Induction Coils.

A description is given in *L'Électricien*, Paris, of a German interrupter for use in Roentgen-ray and other similar work. The arrangement of the interrupter is ingenious and is said to possess some advantages, as it is a mercury interrupter which automatically cleans the mercury. It is simple. The rate of interruption is variable at will, and may be as high as 8,000 a minute.

The device consists of a small electric motor arranged with a vertical shaft and driving the interrupter proper, which is placed above it. The latter consists of a suitable chamber containing 400 grammes of mercury and 180 grammes of kerosene. While stationary the two liquids collect in the bottom of the contact chamber, but when the latter is revolved they are carried out by centrifugal force, forming layers at the outer periphery, while the dirt and oxide collect at the bottom of the chamber. The surface of the mercury is thus always kept clean. Within this chamber is a circular ebonite disc mounted on a vertical spindle placed eccentrically with respect to the axis of the chamber. This disc carries two metal contacts connected together, and to a slip-ring on the spindle. A brush on the latter makes connection with a terminal on the top of the device. The other contact is made through the mercury and the walls of the interrupter chamber.

The action of the device is simple. When the motor is set in motion the mercury flies out to the outer wall of the chamber. In doing this it comes in contact with the contact disc, so that the latter dips into the mercury. This causes the disc to rotate with the mercury, and since it is of smaller diameter the speed of rotation is greater than that of the chamber. As this disc rotates the two metal contacts alternately dip into the mercury and emerge from it, thus making and breaking the contact. The duration of each contact is varied by varying the eccentricity of the spindle of the disc, thus causing the contacts to be submerged in the mercury for a longer or a shorter time. The speed of interruption is controlled at will by varying the speed of the driving motor.

The Economic Waste of Accidents.

A friend of the American Museum of Safety Devices and Industrial Hygiene has offered a prize of $100 for the best essay on the "Economic Waste of Accidents." The committee of award consists of Richard Watson Gilder, George Gilmour and W. H. Tolman.

Professor F. R. Hutton, past president of the American Society of Mechanical Engineers, is the chairman of the committee on admission of exhibits for the American Museum of Safety Devices and Industrial Hygiene, which occupies the entire fifth floor at 231 West Thirty-ninth street, New York. The Museum desires exhibits of devices and processes for safeguarding life and limb in connection with wood-working machinery, railway and marine transportation, mining, agriculture, manufacturing of all kinds. One exhibit already consists of specimens of fifty different kinds of dusts, illustrating the occupational diseases; accompanying each is a photograph of a microscopic section of the lungs, showing the effect on the worker in coal, iron, brass, steel, wood and other dusts. There are also wax models of lungs and hands illustrating those occupational diseases which attack the bones and skin.

All exhibits accepted by the committee on exhibits will be eligible for the gold medal offered by the *Scientific American* for the best device, exhibited at the Museum, for safeguarding life and limb. All inquiries regarding exhibits should be sent to Dr. W. H. Tolman, director, 231 West Thirty-ninth street, New York.

New Tele-Mechanic Device.

By Dr. Edouard Branly.

IN a former account, which was published not long since in the ELECTRICAL REVIEW, were described the leading features of my new "tele-mechanic" apparatus, which is intended to control different circuits at a distance, by means of radio-telegraphy, and I have already applied it very successfully to steering torpedoes in the Mediterranean, from a post on the shore. No doubt it will find other uses in practice. I have been making researches in the apparatus itself, so as to improve it. One of the main improvements is that of protecting it from accidental sparks, and this is almost essential in order to make it work in practice. The matter was mentioned in an editorial in this journal and its remarks were very just on this score. But I had already devised this improvement shortly after making the first apparatus. It is now completed within a recent period, and I am happy to give the ELECTRICAL REVIEW the first complete description and illustrations which have yet been published.

To review the substance of the former description so as to understand the working of the device it will be remembered that the apparatus at the receiving end, which closes the contact for different purposes, is formed of a motor-driven shaft, having mounted upon it a set of discs, one for each circuit. Each disc carries a projecting sector or tooth set at a different angle, which strikes a lever upon revolving, and this closes the circuit, say, for a set of incandescent lamps. The second disc closes a motor circuit, and so on. Taking the case of disc No. 1, its sector closes, for a certain time, a circuit containing a coherer and a sensitive relay. Should the distant station send a spark during this time the coherer works, and the sensitive relay sends a current into a heavy relay which closes the lamp circuit. However, as the latter relay is double-acting, the next revolution, or contact, will open the switch should a spark be then sent. If not, the lamps continue to be lighted. The sending post must know just when to send the spark for operating the right device or disc. For this it receives signals from the receiving post. Upon the shaft is mounted a special disc. It has five sections, corresponding to the five discs. In each section is a set of tooth projections which send electric waves to the first station, and these waves are recorded as dots upon the operator's tape. There are five signals: No. 1 is formed of one spark from one tooth; No. 2 from two teeth, etc., and the space between the signals corresponds to the active position or contact of each sector of a disc. In the diagram this is clearly seen. The operator sees that between Signal 1 and Signal 2 the disc No. 1 has its sector in the active position. He then sends a spark in this interval and can light the lamps before Signal 2 arrives. Then he can send a second spark to drive a motor in Interval 2, and so on. Inversely, he can shut off the lamps when Interval 1 passes again, and the motor in

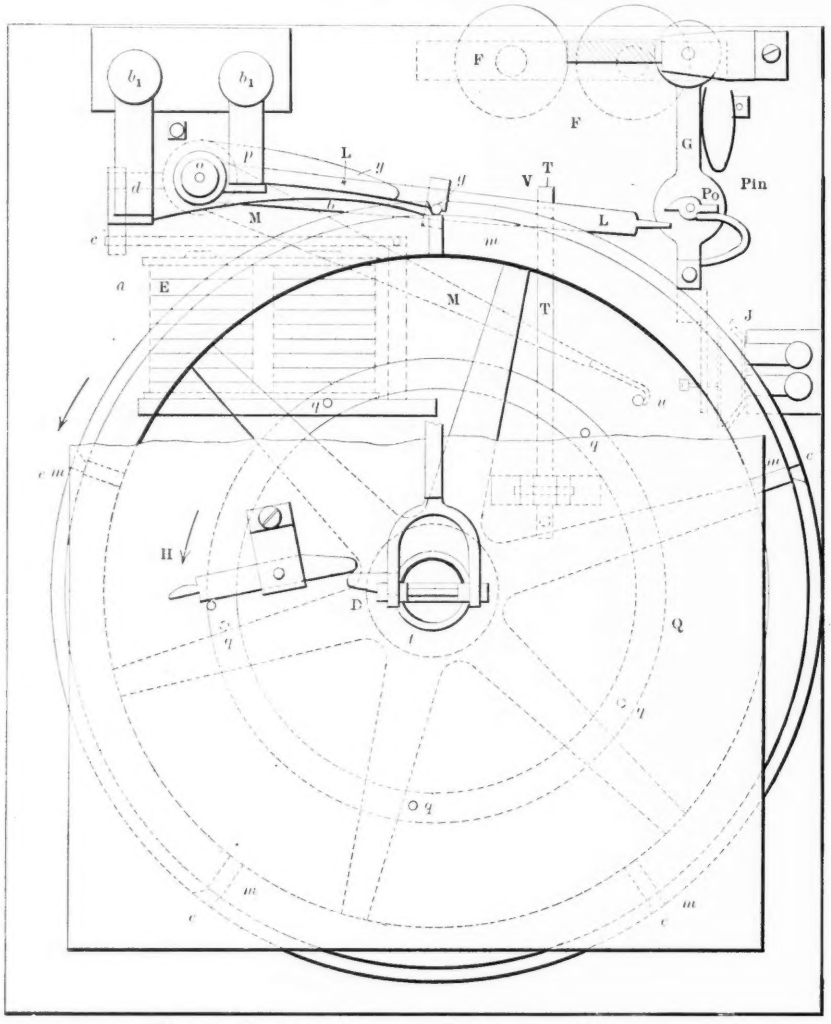


FIG. 1.—OPERATING PARTS OF BRANLY TELE-MECHANIC.

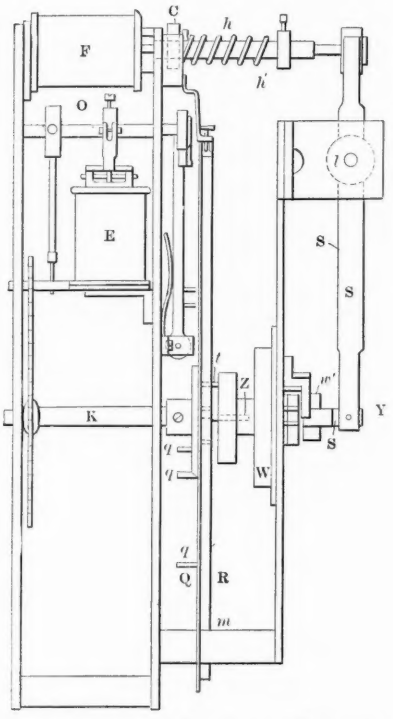
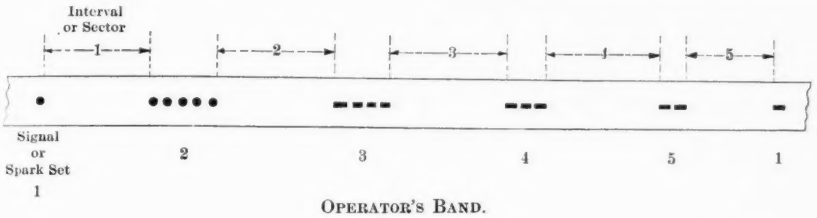


FIG. 2.—DETAILS OF CONTACTOR MOVEMENT.

Interval 2, and thus has the device under control.

The device is shown in the accompanying diagrams. A wheel R placed on the shaft A is given a regular rotary movement by clockwork or an electric motor. The circumference of the wheel is of insulating material, except on the very narrow conducting parts *m*, upon which bear two parallel brushes *b* and *b'*. The circuits of the brushes end at the plugs b_1 b'_1 of the work circuit, so that the circuit is closed every time the brushes come upon the contact when the wheel revolves. There are a number of such contacts, spaced around the wheel equidistantly, and five of them are shown here, but the number can be varied at will to suit the case. The security is increased in proportion to the number of contacts used. Wheel R has a larger disc or flanged part (see side view) and this carries grooves *e* in it lying at the point of the contacts *m*. On the shaft is a ring Q, solid with the wheel, and upon it are fixed the projecting pins *q*, equal in number to the contacts. Between the two supporting plates of the apparatus is a shaft O which can be turned by an electromagnet E lying in the work circuit. Its armature is fixed by means of *c* and *d* to a collar *f* mounted on shaft O. On the same shaft are fixed the levers L and M. Near the middle of lever L is a pin *g* which projects on the side next the wheel R, and it can fall into the slots *e* cut in the wheel. The lever M ends in a curved hook *n*, and normally it is engaged with a stop pin or lever which controls the clockwork, and the latter is stopped. Lever L is also raised by the magnet and when at the top it can remain there by a catch after the current is cut off. To do this the vertical rod T is pushed against lever L by means of the spring *y*. The rod has a shoulder *v* on the top, so that the lever can rest upon it in this position. At the lower part and opposite the circle of the pins *q* the rod T is cut in bevel, as seen in Fig. 4, so that when the pins *q* strike it they push it back and the lever L falls off from shoulder *v* at the top. This lever carries a projection on the end which strikes a double cam *p* mounted on the lever G. The latter is hinged at the upper part of the apparatus. The cam is controlled by a spring so that it can be stopped in one direction by the pin *p* of the lever G. Therefore, when the lever L goes upward and strikes the cam, the latter turns on its pivot, compressing the spring and this takes place until L escapes from the end of the cam. When, on the contrary, lever L is brought to the lower position, it strikes the curved part of the cam, and as the latter can not revolve on account of the stop pin *p*, lever G is displaced as a whole and swung along with the cam toward the right. By so doing an electric contact is made at J and closes the circuit of electromagnet F. Its armature C (see Fig. 2) is connected by a rod *h* with a double-fork lever S, pivoted on the shaft I (Fig. 3). A spring keeps the armature normally away from the magnet. The fork of S embraces a piece *s* in the form of an H. The latter piece holds a sleeve, W', which is fixed on the shaft W. On this shaft is also mounted the cam D by a set-screw and a disc Q'. The latter carries the projecting pin *q'*. Q' is centred on the main wheel R by a tenon on the main shaft K which fits loosely in the hole in *w* (see also Fig. 1) at Z. The pin *q'* can fit into any one of the five holes *t* placed in the main wheel R and a spring serves to keep it thus. In this position, when the disc Q' is revolved by the clockwork, it compresses a spiral spring contained in the cylinder *w''*, and thus when pin *q'* is drawn out of the hole *t* of the main wheel, this spring draws the disc Q' back to the normal, and also restores cam D to its normal position. Facing this cam (Fig. 1) is a lever H which closes the circuit of the apparatus which is to be worked by the present device, this being a Morse instrument, for instance, or an incandescent lamp circuit, an electromagnetic device of any kind, etc.



OPERATOR'S BAND.

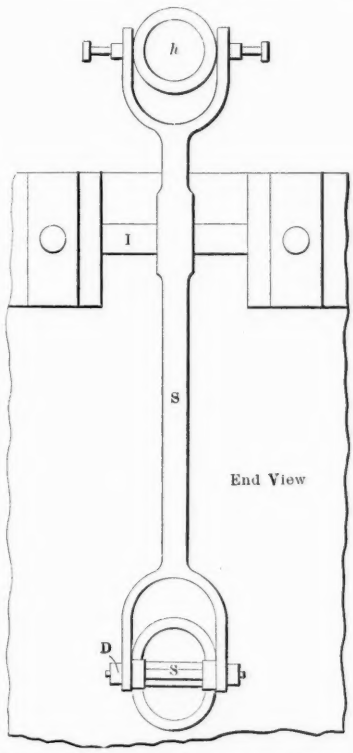


FIG. 3.—DETAILS OF LEVER AND SHAFT.

The device works as follows: Normally, cam D lies below the contact lever H, and the brushes *b b'* lie upon contact strip *m* No. 1. Should an electric wave be sent from the other station, the coherer acts, working a relay. A circuit is closed, therefore, through the contact *m* by a local battery, and the current passes in electromagnet E. Its armature *a* is lifted for an instant and by turning the shaft O it raises both levers L and M together, as these are fixed solidly to O. The hooked end *n* of lever M sets free the clockwork or motor movement by releasing the lever or pin at *n*, and the clockwork starts up. At the same time the pin *g*, carried by the lever L, which remained in the slot *e* of wheel R, is lifted out of the slot. The wheel thus freed is set in rotation, but the work circuit remains open during the first fraction of a revolution, for the brushes are now upon an insulating part of the circumference, having left the contact

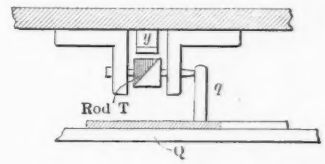


FIG. 4.—DETAILS OF CONTACTOR MOVEMENT.

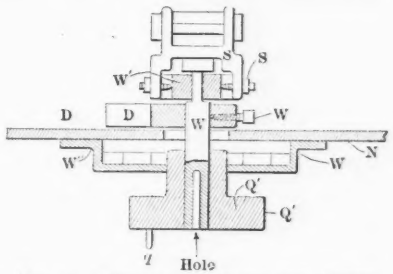
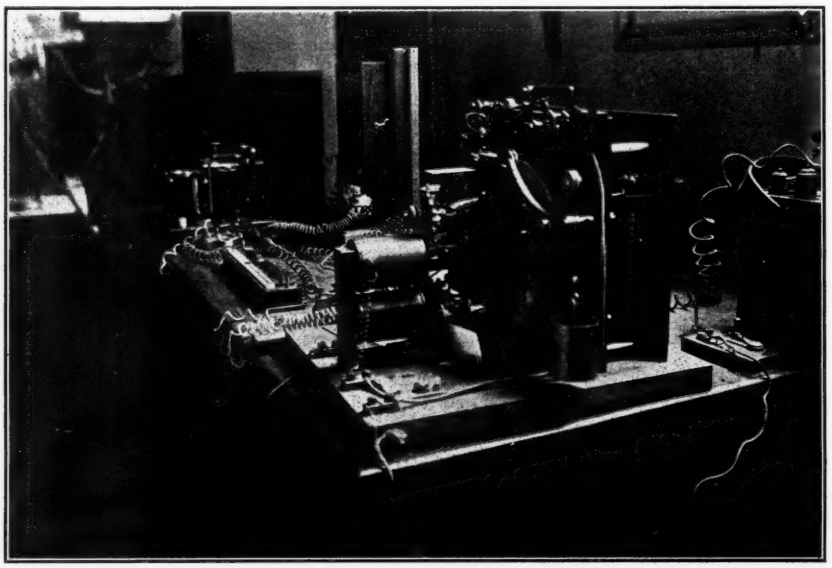


FIG. 5.—DETAILS OF SHAFT AND LEVER.

strip. When the wheel begins revolving, the first of the pins q (No. 1) strikes rod T and pushes it back, as we have seen. This frees the lever L (which when it rose, rested on the end v of the rod) and the lever not being held, falls through a small angle and the pin g slides on the circumference of the wheel until it falls into the next slot e. Then lever L stops its movement. Lever M has fallen at the same time and its hooked end n stops the motor. This lever has also pushed the lever G and made contact at J, closing the circuit of the magnet F. Its armature C (Fig. 2) moves the lower end of the lever S and this releases the pin q from the hole t of the main wheel, which it occupied, allowing the spring of w'' to restore cam D (which had been drawn along with the main wheel R) to its initial



Complete Branly Tele-Mechanic with Coherer, Relay, Etc.

place, independently of the wheel. Since cam D does not make a complete revolution, it can not come above the contact lever H so as to act upon it. In order to have the pin g fall into a slot and therefore to have the other parts restored to their first positions (or non-action), a spark or electric wave must not occur at the moment of contact between b b' and the second contact (No. 2). Should such a spark occur at this precise moment, wheel R and cam D continue to revolve, since the armature of electromagnet E having been attracted anew, lever L has been kept lifted and the pin can not fall into the slot e which came opposite it. Thus the wheel keeps on revolving for a second one-fifth revolution. If there is no spark at the third contact of the brushes, on the contrary, the motor and wheel stop again, and cam D comes back to its normal position. Should there be a spark at this passage of the brushes (No. 3) the wheel will keep on revolving until we have the contact No. 4 under the brushes, and so on. At contact No. 5, supposing that we had sparks at Nos. 1, 2, 3 and 4, should there be a fifth spark, the action continues and now the cam D completes its course and is above the lever H. It now trips this lever and makes the contact for the lamp circuit, for instance, which is the object of the present action.

The cam then comes regularly to its first position, and the wheel is stopped here, with the brushes lying upon contact No. 1 as at first. We are then ready to commence as at first. In order that the lamp circuit should be closed by an accidental spark, or group of sparks, there must occur five sparks just at the points of revolution, Nos. 1, 2, 3, 4 and 5, which, unless the sparks were set in a continuous stream, is more than improbable. In fact, wheel R is fifty centimetres in circumference and makes a revolution in twenty seconds, the width of contact m being but one millimetre. An accidental set of sparks could not therefore work the lamp circuit unless among the number there were five sparks occurring at five equidistant intervals of time, each interval having a duration of one-twenty-fifth of a second. We see that practically this could not occur for accidental sparks. Besides, according to the nature of neighboring disturbances; it is easy to vary the time of one revolution and the number of the contacts. While it is true that a special apparatus sending out a continuous jet of sparks could cause the action, the present device seems to be all that is needed to take care of accidental sparks.

This device is now to be combined with the apparatus which we first described, or the set of five discs which control five different circuits, for instance. This is carried out by placing one of the new apparatus for each of the five circuits. Supposing the lamp circuit, operated by disc No. 1; this disc closes the circuit of the electromagnet E and we have seen that this action causes the closing of the switch H when a continuous set of sparks is sent during the revolution of the wheel Q. The clockwork causes the latter to make one revolution in the time denoted by interval No. 1 on the operator's tape. During this time he could have sent a single signal to operate the lamps by the old method, but now he sends a continuous set of sparks in this interval. The clockwork apparatus thus keeps on revolving and, at the end of its course, throws the switch H for the lamp circuit. During interval No. 2 the operator again sends a succession of sparks, and as the motor disc, including its own clockwork device, is now in action, the motor circuit can be closed, and so on. In short, the working is the same, with the addition of a clockwork device in each disc circuit. The total duration of the spark jet is about twenty seconds for one interval.

Merchants' Association Secures Reduced Railroad Fares.

The Merchants' Association of New York announces that its application for merchants' rates to New York during the Spring buying season has been granted by the Trunk Line Association. The rates will be in effect on February 29 to March 4, inclusive, and March 14 to March 18, inclusive, with the customary fifteen day return limit. The special rate for the round trip will be one fare and one-third, effective under the certificate plan.

Geographically and roughly described, the territory of the Trunk Line Association is in New York, Pennsylvania, New Jersey, Delaware, Maryland, District of Columbia and in Virginia, north and on the line of the Chesapeake & Ohio Railway. The concession does not apply from points less than 100 miles from New York city.

The Conservation of Fuel and Other Natural Resources of the Country.

At the meeting of the American Institute of Electrical Engineers, held in New York city on December 13, Dr. J. A. Holmes, of the United States Geological Survey, addressed the members on the subject of the "Conservation of fuel and other resources of the country, and the investigations being made by the Government to establish data of value in estimating the usefulness and extent of our natural resources." After briefly referring to the economic reasons for these investigations, Dr. Holmes continued as follows:

The industries of the country are growing at a wonderfully rapid rate. You perhaps hardly realize the fact that during the past year there were used in making power or heat four or five million tons of coal; that during the ten years from 1895 to 1905 there were consumed nearly three billion tons of coal in the United States, and that this consumption —and this is the most interesting point which I want to make in this connection —was equivalent to the coal used in the United States during the preceding seventy-five years. It is interesting, as noting the rapid rate in the development of these industries, that during each one of these decades in the past eighty-five years the amount of fuel consumed during any one of the decades was equal to the total sum used during all the preceding years. I have no doubt that during the decade from 1905 to 1915 there will be consumed in the United States an amount of coal equal to that used during the previous ninety-five years. These industries must continue to grow, and the basis of this growth must be the continued supply of cheap raw material, but the future growth of the industries is impossible except as we perpetuate the supply of these materials. The nation has grown up in luxury; and because of this abundance of its resources we have developed a habit of waste.

This conservation means, first of all, the prevention of waste. In the care of our forests it means to stop the useless forest fires, which in the past have consumed as much timber as the lumbermen of the country have cut; stop the destruction of timber for the sake of getting the bark; stop the unnecessary destruction of young growth and make use of every available part of every tree that is cut. It means the use of preservatives or treating processes which will multiply the life of the crosstie or the life of the plank several fold.

In the water supply and forest together it means covering our many barren hills with forests and the construction of reservoirs which will conserve the water supply by giving us a more uniform flow in our streams, thus preventing the waste which takes place when we have a flood one day and a dry stream the next; and this uniform flow of water then becomes available for power, for irrigation and for navigation.

It means the prevention of waste in our mineral resources; waste in mining, waste in handling, treatment and use of these resources.

In the second place, it means that we should use these resources with the highest efficiency attainable, so that each pound of material can be made to yield the maximum service. Using our fuel resources as an illustration, we have been allowing our natural gas to burn continuously in the open air; we have been wasteful in the development of our petroleum supplies; we have been wasting nearly fifty per cent in the mining of our coal, and of the coal which reaches our furnaces, as a rule, not more than five per cent of the heat is converted into the actual work of manufacturing. Of the 100,000,000 tons of coal used in the railway locomotives each year not more than five per cent of the heat developed is converted into the actual work of pulling trains. But these railways must each year haul 3,000,000 cars of coal to keep these locomotives moving.

WHY RESOURCES SHOULD BE CONSERVED.

1. Because the supply of these resources is limited, and considered in connection with the life of the nation their early exhaustion is certain unless we learn to use them more efficiently and stop this waste.

Using as an illustration one of two most important solid resources, the best part of the iron ore supplies of the country at the present increasing rate of consumption will be used within the next fifty years; and while our coal supplies may be expected to last for a longer time, the fact remains that our high-grade coking coals are disappearing so rapidly that the lands containing them in many cases are now valued at from $500 to $2,000 per acre. Our supplies of smithing coal are quite limited, and even of the ordinary steaming coals we are now using the best and cheapest supplies; and the immediately succeeding generations will have to pay a considerably higher price for their fuel, because the mines will be deeper and more dangerous.

2. This exhaustion of our mineral resources is a permanent exhaustion. One year's wheat crop when consumed is replaced by that of the succeeding year. Even the forest resources, requiring a century or more for a growth, when exhausted may be replaced in time by a succeeding growth of forests; but when the deposits of coal, oil, natural gas or iron ore have been exhausted, this exhaustion is permanent.

3. The existing mineral resources of the country have required for their accumulation thousands of millions of years. Not only will an exhaustion of these resources be certain and permanent, but we know of no new supplies of these resources that are now being formed and which could in future take the place of the exhausted supplies in meeting the needs of future generations.

4. The United States need not expect to draw future supplies of fuel from other countries, as no other country can spare from its own reserves sufficient quantities to meet any appreciable part of our own growing needs.

5. The future ascendency of American industries must depend largely on our manufacturers being able to secure cheap fuel. The value and cost of labor will never be reduced in the United States to what they are in foreign countries; but this fact renders it all the more essential in the struggle for industrial and commercial supremacy that the manufacturers of this country be able to obtain fuel supplies cheaper than they are to be had in other countries. The fuel bills of this country during the past year approximated $2,000,000,000. This enormous cost will increase rapidly unless we learn how to use our fuels more efficiently.

HOW CAN THIS CONSERVATION BE BROUGHT ABOUT?

1. Methods must be devised by the use of which the waste in mining operations can be greatly reduced, without destroying the profits of the mining industry.

2. Similarly there must be devised more efficient methods for handling and treating these materials in preparing them for use.

3. New methods must be devised or old methods so improved as to render possible higher efficiency in the burning of fuel or transforming it into actual work.

4. Every effort must be made to discover satisfactory substitutes for existing mineral products, the supply of which is likely to be exhausted at an early date in the life of the nation.

All available information relating to these subjects should be placed before the

people of the country as rapidly as the facts can be ascertained, and in such form as to be readily understood. Both the producers and the consumers of these resources can be expected to cooperate in remedying the existing evils as fast as the commercial conditions will permit, but should legislative measures prove necessary, reliable data obtained by the Government in the investigation of these products will then serve as an intelligent basis for such legislation.

GOVERNMENT INVESTIGATIONS.

The United States Forest Service, which has developed so rapidly and so efficiently during the past dozen years, is impressing the American public with the importance of forest conservation; it is doing much to diminish the destructive forest fires; it is protecting, developing and extending the national forest reserves which now embrace more than 150 million acres in the western states and territories. It is cooperating with the holders of many private forests in the inauguration in their management of modern forest methods; it is stimulating the planting of new forests; it is encouraging the states to join in this movement for forest improvement and forest perpetuation, and it is doing much to show how the life of the timber may be extended by various treatment processes.

In the investigation of mineral resources the technologic branch of the Government Geological Survey, under an advisory board, on which the American Institute of Electrical Engineers and other allied organizations of the country are represented, has accomplished much during the past three years in the way of investigating the nature and extent of the waste of coal in mining operations, and also in demonstrating how the different grades of coal after they have been mined, can be used more efficiently. It has shown that the lignite coals, occurring in thirty or forty million acres of land still belonging to the Government, can be used in the modern gas producer, developing power equal to that obtained by good eastern steaming coals when used under the ordinary boilers. It has demonstrated that the low-grade bituminous coals, aggregating many millions of tons annually, which are now being thrown away or left under ground and permanently lost, may be utilized on a satisfactory commercial basis through the use of the gas producer and gas engine. It has collected with great care from the coal beds in every part of country an elaborate series of samples, of which chemical analyses and calorimeter tests have been made, and which are now available for general use. It has demonstrated that a considerable part of the slack coal of the country, especially the non-coking slack coals—which are the least valuable—can be briquetted on a commercial scale and thus given a value as great or greater than that of the lump coal. It has shown how many of the so-called non-coking coals of the country can be made into commercial coke, and it has demonstrated that not only many of these bituminous coals, but also that lignites can be utilized for the manufacture of valuable by-products. In an educational way it has endeavored to bring those in charge of the various industries of the country to realize that all fuels should be purchased on definite specifications, and should be paid for approximately in proportion to the heat each will yield.

In connection with the investigation of structural materials, under the same advisory board, the Government is also doing much to show the possibilities of increasing efficiencies in the use of reinforced concrete and other building materials. We are testing materials of construction as well as fuels that are being used by different branches of the Government service, and thereby increasing efficiencies in the use of these materials.

This work already done by the Government along these lines and the results accomplished are but a beginning or a suggestion as to what should be done and what could be accomplished in the immediate future with better equipment, and a larger number of trained experts.

The President in his message to Congress has recommended the immediate extension of this work. When it is remembered that the mineral production of the United States during the past year had an aggregate value of more than $2,000,000,000 and that the waste of materials in this production was equivalent to a deplorably large percentage of this enormous sum; that of a fuel bill of nearly $2,000,000,000 but five per cent was converted into actual work, no one can question the importance of having this entire subject investigated in the most thorough manner possible.

THIS IS A NATIONAL QUESTION.

In every civilized country fuels, like water and forests, are coming to be regarded as public utilities, and the conservation of these and other natural resources is properly coming to be regarded as a national problem, for the reason that in every country these materials serve as a basis of national welfare.

The individual citizen looks to the present. He sees but little beyond his interest in the work and the profits of to-day. The nation, while helping the citizens of to-day, must safeguard the welfare of the citizens of to-morrow by a judicious conservation of these resources, which in reality and in a higher sense belong not to the individual but to the nation.

The doctrine that self-preservation is the first law of nature is no less applicable to the nation than it is to the individual. The brave and patriotic individual has ever been willing in time of war to give up his life, if needs be, in order that the nation might live. Now in time of profound peace we are asking no one to die. But let us realize that this nation is entitled not only to life, but to a great future as well as a great past, and let us act accordingly.

We are now dealing with problems that have to do with the life of the nation in time of peace, both present and future. These are problems which deserve and need for their proper solution the highest type of patriotism, American business sense, statesmanship and scientific attainment. I commend them to the earnest consideration of the members of this great society.

Underwriters' National Electric Association.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held in March, 1908, in New York city. The day and place of the meeting will be announced later.

As usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in or addition to the code be forwarded to C. M. Goddard, secretary of the Electrical Committee, 55 Kilby street, Boston, Mass., on or before February 1, 1908, in order that it may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider same in advance of the meeting. Final action on suggestions not received in season for consideration by the committee before the meeting can only be taken by unanimous consent.

As heretofore, the meeting will be open to all interested, and such persons will not only be welcome, but are urged to be present and give the committee the advantage of their experience and advice.

NOTES ON THE ELECTRICAL OPERATION OF TEXTILE FACTORIES.[1]

BY H. W. WILSON.

Three years ago the actual horse-power of motors installed for driving textile factories in Great Britain was limited to a few hundreds, practically all in one mill, and only a very small fraction of the then total was actually in cotton mills.

So far as it has been possible to estimate from answers to inquiries sent by the various firms interested, the total horse-power which will be installed and running by about the end of March, 1908, will be about 28,000, and this is almost entirely in cotton spinning mills. These figures show, of course, that a very distinct progress has been made, and that the conservatism of the textile manufacturers with regard to the driving equipment of their factories is being slowly broken down.

When, however, it is considered that in the United States and Canada there is something like 250,000 horse-power of motors installed in textile factories, and that the orders for such machines received by one firm during the past half-year, for supplying various mills in the United States, amounted to about 25,000 horse-power, or practically as much as has been done in Great Britain in three years, and when besides it is remembered how very much the total power requirements of the British mills exceed those of the United States, it will be recognized what immense room there is for further development here.

There has been almost endless discussion in various newspapers concerning the advantages or disadvantages of the electrical driving of textile machinery, and some very exaggerated statements have been made on both sides. This is a circumstance greatly to be deprecated, as it tends to prevent fair consideration of a question that is worthy of the most careful investigation. There is also an unfortunate tendency on the part of the various electrical manufacturing firms who are carrying out work of this class to try and impress upon the minds of their customers that by some special system of their own they are inevitably bound to get better results than any of their competitors. Statements of this kind are hardly justifiable, as it is, of course, apparent that there can not possibly be anything particularly novel in the design of the machines which are installed.

[1] A paper read before the Manchester section of the Institution of Electrical Engineers of Great Britain, November 18. Condensed.

Every one agrees that for work of the class under consideration a three-phase equipment has decided advantages over a direct-current, and in the absence of a satisfactory single-phase motor for anything except very low periodicities, there is no doubt that the present general course of action will continue.

It is quite obvious that an induction motor, either squirrel-cage or slip-ring, made by one manufacturer does not differ very materially in its performance from a machine of the same class made by another, and that provided the same guarantees as to the behavior of the machines are given by any two firms the results which will be obtained when in operation will be the same. It may appear unnecessary to emphasize this point so much, but it must be remembered that persons who are not electrical experts, and having very little knowledge of the actual design of electrical machinery are apt to be misled by manufacturers who state their's is the one and only system which will give perfect results in operation. There is no special system in the driving of a textile factory which will inevitably give the best results, but there is scope for the exercise of an immense amount of judgment and knowledge of the conditions to be met in the arrangement for the driving of the various textile machines.

The advantages which the advocates of electrical driving urge for the operation of large textile factories are as follows:

1. The mill and the engine house can be placed each in its most convenient situation without any regard to the relative positions.

2. The internal arrangements of the mill as regards shafting, gearing, belt and rope drives, etc., are greatly simplified and their costs reduced. The flexibility as regards extensions is, of course, obvious.

3. The grouping of the machines is much less arbitrary than in a mechanically driven mill, as the motors and the comparatively light shafting required by them can be placed where most convenient.

4. The reduction of the chance of a breakdown, which would stop the whole mill, to a minimum.

5. The ease of running one section for overtime or on special work.

6. The reduction of the maintenance and depreciation charges.

7. The greater steadiness of drive which can be obtained under suitable conditions, with a subsequent permissible higher speed and increased output.

8. The reduction in the total capital cost of the mill per spindle or per loom with a factory of above a given size.

9. The possibility of keeping a constant check upon the results obtained in each department of the factory.

In addition to these advantages it may now be claimed that a better price can be obtained for the product of an electrically operated factory than for that of a mechanically driven one, and as regards this point I have definite information that this statement is correct, though I am not at liberty to give the exact figures or to mention any names.

It is also a fact that Clause 7 in the above list has now been proved conclusively, but in this instance also the manufacturers display considerable disinclination to allow the publication of definite figures, though some of them are prepared to admit that they would continue electrical driving even at a greatly increased cost on account of the much better results which are being obtained. It might be mentioned, however, that in the case of one large installation which has recently started work that the management in making their calculations admitted that from the evidence before them they were certain to obtain an increase in output when the mill was being driven electrically, and they took this fact into their calculations.

The objections referred to previously are as follows, and so far as I am aware no further serious points have been raised by the opposition side.

The first objection is that the reliability of electrical driving has not been sufficiently proved.

Secondly, that the capital expenditure involved in the adoption of the electrical system is so great in comparison with mechanical driving as to put it out of court.

Thirdly, that it is only advantageous in special cases, or where the average load-factor is poor.

Fourthly, that the efficiency of a mechanical drive is considerably higher than that of an electrical one.

The first objection may now be regarded as finally demolished, as of recent times I have never found that even the most bigoted objectors tried to contend that electrical machinery was not reliable in operation, and when it is considered that at the present time three-phase motors are working with perfect satisfaction under the very severe conditions of mining and rolling mill work, it is fairly obvious that

the comparatively light duty of a textile factory presents no difficulty whatever.

The second objection, which is almost answered by the eighth clause of advantages, may now be fairly definitely withdrawn from the list. The capital expenditure is, of course, high when a small factory is being considered, but with a large spinning mill of, say, 100,000 spindles, after making allowance for all the structural alterations which can be effected, there is absolutely no increased capital expenditure, and if the factory increases in size beyond this limit the electrical equipment will work out more cheaply than the mechanical. The important items, of course, are the total abolition of the rope race, which under ordinary conditions is an expensive structure, and the reduced cost of gearing.[1] There is one example of a factory in this neighborhood which is electrically driven, but where the rope race was built in order to allow of mechanical driving if the electrical proved unsatisfactory; this course is not likely to be followed in the future.

The fourth objection is still brought forward with commendable regularity, and it is in the nature of the case a very difficult thing to disprove. The actual efficiency of an electrical system of driving can be ascertained easily, but the efficiency of a mechanical system under running conditions it is impossible to obtain accurately. It may, however, be of interest to note that where a mill has been converted from a mechanical drive to an electrical one, the indicated horse-power of the prime movers has been reduced with the same machinery running, and this certainly tends to show that the efficiency of mechanical drives is not usually as great as stated by its advocates. The probability is, however, that as between a well laid out electrical drive and a perfectly modern mechanical drive there is very little difference indeed in the actual efficiency of transmission—that is to say, as regards the total power delivered to the machines by the driving mechanism. This does not, however, dispose of the fact that the motors deliver the power in a rather better manner—that is, at a more constant speed.

The subjects which seem to the author to be most worthy of discussion are these:

First, the advantages and disadvantages of grouped and individual driving for the various classes of textile machines;

Secondly, the advantages and disadvantages of squirrel-cage and slip-ring motors respectively; and

Thirdly, the consideration of the best type of prime mover, where the factory has its own power plant.

Arising out of this latter point is the consideration of the advantages of the centralization of the power plant for a number of factories, which was a subject briefly referred to in the previous paper.

Three years ago it was stated that for the preparation machinery, including bale breakers, blowing machines, scutchers, cards, combers, roving and intermediate frames, group driving was the correct course to pursue, and when considerations of the capital cost are taken into account, there is still no doubt that this is the best practice.

It was also then stated that for mule driving the grouping of the machines was essential, and this statement held good until very recently. My own experience certainly points strongly to the advantages of a group drive for this class of machine, but recently satisfactory results have been obtained from a motor driving a single mule with a suitable arrangement of flywheel effect in the system. It would seem doubtful even yet whether as good results can be obtained from this as from a group drive, although the users appear to be perfectly satisfied, but it is certainly worthy of interest to note that successful results have been obained at all, considering the exceedingly variable load that a single mule spinning frame gives.

The keenest argument over group or individual driving has arisen in connection with ring-spinning and ring-doubling frames. These machines individually give a practically constant load, and it is a very simple matter to couple directly a motor of, say, from five to ten horse-power, according to the size of the frame, to the machine and thus do away with all possible slip or transmission losses. It is, however, to be remembered that in a number of factories the ring frames are not always spinning the same class of counts, and, in consequence, a speed variation of the spindles becomes necessary. To effect this variation, in a large number of cases slip-ring machines with wound rotors have been installed, and the variation is obtained by inserting resistance in the rotor circuit.

There are three objections to this arrangement, which is, of course, in other respects a most convenient one, the first being the initial capital outlay upon the installation; the second, the low efficiency of the motors when running with the resistance in circuit; and, thirdly, the objection which has several times been expressed to the heating of the resistances, which has sometimes been the cause of considerable annoyance. Textile manufacturers are generally apprehensive of the heating of resistances to a temperature which, from an electrical standpoint, is perfectly safe, but which they regard as dangerous; and as the ordinary factory is always at a fairly high temperature, it is difficult to get efficient cooling without building rheostats of abnormal size. It would therefore appear as if in future installations of this character special cooling arrangements would have to be considered.

In cases where individual driving is adopted, but where speed variation on the spindles is not necessary, squirrel-cage motors with some form of a friction clutch as a coupling have frequently been used, and have given satisfactory results. The capital outlay on these machines, including the clutches and auto-transformer starters, is distinctly less than upon the wound-rotor machines with regulating resistances, even although in this case the clutch coupling is not necessary.

The alternative arrangements for the driving of frames where variable speed is essential is to group the machines and drive with a single motor, changing the pulleys for speed variation, as is customarily done with the mechanical arrangement.

Arising from this question of the method of driving is the possibility of direct coupling the motors to the line shafts in nearly all cases for group driving, and this course of action has now been found to be possible to a greater extent than the manufacturers were at one time prepared to admit.

Having become accustomed to certain shaft and pulley speeds as being on the whole the most convenient for a mechanical transmission, considerable difficulty was found in inducing them to depart from what they regarded as a standard arrangement; but it is now, in nearly all cases, found possible to speed the line shafts up to an extent that will permit of direct coupling to standard speed induction motors without any objectionable results arising. This arrangement materially reduces the transmission losses between the prime movers and the textile machines, and also eliminates some possibilities of slip.

In several installations in this district, however, the mechanical arrangements, and, in fact, the placing of the motors generally, do not appear to have been given sufficient consideration; and the assumption seems to have been that, pro-

[1] See Schedule I.

vided one is using motors, the method of fixing and the arrangements of the drives from them were of small importance. This has naturally led to a certain amount of dissatisfaction. These cases, however, when contrasted with the installations which have given exceedingly good results in other factories, merely emphasize the necessity for the careful consideration of the actual requirements of the machinery to be driven before the work is carried out.

In other cases those responsible for the layout of the installation appear to have overlooked the fact that it is almost as inadvisable to have the motors too large as too small, and this is a fault which exists in some recent instances.

Electrical manufacturers generally do not appear to realize that the actual powers required need very careful investigation before the machines are actually installed, and it is by no means a safe rule to assume that the horse-power is so much per one hundred spindles of the mill, as this may lead to considerable error. If a large mill engine is being put down to drive the whole of the plant, it may be perfectly safe to use such general assumptions; but when what is practically equivalent to a subdivision of the prime mover is made, the most careful consideration of the power taken by each section of the installation is essential.

In considering this it is necessary to know the class of material which is to be produced, as figures from one mill only would be very misleading applied to another mill with the same class of machines but manufacturing a different grade of material.

Regarding the question of the prime mover, if the mill has its own installation, one approaches a subject which is open to practically endless discussion. Installations either in operation or approaching completion comprise standard mill engines driving generators through ropes, mill engines direct coupled to generators, quick-revolution generating sets, and turbo-generator sets. It is only needful for a gas-driven set to be installed to have complete examples of almost every type of prime mover which is possible in this country.

From the point of view of perfect angular velocity the turbine offers obvious advantages, and, in addition to this, for large sizes the capital cost per kilowatt is fairly reasonable.

My own preference for a mill of, say, less than 1,000 horse-power would certainly be in favor of a quick-revolution reciprocating set, but the slow-speed engine makers are now prepared to guarantee such favorable results in steam consumption that in spite of the extra capital cost their claims demand careful consideration. There is, of course, the added advantage that the average mill engineer is more familiar with the slow-speed engine than any other type, and under ordinary conditions repairs and maintenance will be a small item.

It must be remembered that the ordinary mill engine runs about fifty-five or fifty-six hours a week under practically full load, and that it is usually of 700 to 1,500 horse-power in size. It is manifest also that with the distinct advances which are being made in gas-engine design that gas-driven generating sets will in the future demand consideration. Particularly is this the case as the makers are now prepared to guarantee very constant angular velocity, which in the past has been one of the principal drawbacks of gas engines for the class of work under discussion, where constant speed is of the utmost importance.

It might be mentioned, in passing, that in the case of one mill supplied from a central station the mill authorities stated they were able to tell, by the behavior of the machinery, when they were being run off the steam turbines and when off the reciprocating engines, and very much preferred the former.

The other point which I would suggest as one that might be usefully discussed is that of power supply from a central generating station. Of the total horse-power in motors now installed in textile factories in Great Britain some twenty-five per cent to thirty per cent are driven from central generating plants, and this proportion shows every sign of increasing rapidly.

Upon the occasion of reading a previous paper I did not feel that the central supply authorities would be able to induce proprietors of spinning mills to take a supply at a price much above 0.7 cent a kilowatt-hour in the case of large mills in the Lancashire district, where coal is cheap. This, however, is merely another case showing the unwisdom of prophecy, as it is common knowledge that some large factories are now paying considerably above this price, and are perfectly satisfied so to do; and, as regards mill-power costs, refer to Schedule II.

The advantages of taking a supply of energy hold good in an intensified degree to-day. In the first place, if the mill-owners make a contract for power at a fixed price they become largely independent of the fluctuations in the price of fuel and also of strikes; they are freed almost entirely from all anxiety as regards stoppage from breakdown, and, in addition, the capital expenditure saved on the generating plant can be very much more usefully employed in productive machinery. This is a matter of very great importance in times like the present, when

SCHEDULE I.

COMPARISON OF CAPITAL OUTLAY FOR A SPINNING MILL OF 100,000 MULE SPINDLES.

Driven: *(a)* By Ordinary Mechanical Means.
(b) By Three-phase Electrical Transmission.

(a) Mechanical.		(b) Electrical.	
Engines, piping, etc., erected	$30,000	850-kilowatt turbo-generator and auxiliary complement	$33,000
Boilers	10,000	Boilers	10,000
Chimney and boiler settings	5,000	Chimney and boiler settings	5,000
Reservoir	7,500	Reservoir	7,500
Engine house	3,000	Engine house	2,000
Engine bed	3,000	Engine bed	1,500
Rope race	2,500	Motors, cables and switchboard	14,910
Boiler house	2,500	Boiler house	2,500
Economizer and house	3,750	Economizer and house	3,750
Lighting generator and setting	6,000		
	$73,250		$80,160
Gearing	15,000	Gearing, $2,750; pulleys, $1,250	4,000
Total	$88,250	Total	$84,160

SCHEDULE II.

COMPARISON OF RUNNING COSTS FOR A SPINNING MILL OF 100,000 MULE SPINDLES.

Driven: *(a)* By Ordinary Mechanical Means.
(b) By Three-phase Electrical Transmission.

(a) Mechanical.		(b) Electrical.	
Coal, 1,500 I.H.P.	$6,797.00	Coal, 1,400 I.H.P.	$6,343.75
Wages—Engineer, $13.75; assistant, $7.50; 2 stokers, $7	1,762.50	Wages (no assistant)	1,385.50
Oil, etc.	625.00	Oil, etc.	625.00
Insurance—E, $500; B, $110; gear, $300; buildings, $100	1,010.00	Insurance—E, $500; B, $110; gear, $80; buildings, $50	740.00
Taxes, $1.75 on 5 per cent of $73,250	1,282.00	Taxes, $1.75 on 5 per cent of $80,160	1,403.75
Interest and depreciation, 12 per cent on $88,250	10,590.00	Interest and depreciation, 12 per cent on $84,160	10,108.75
Total	$22,066.50	Total	$20,606.75

Cost per kilowatt-hour for 850 kilowatts, 56 hours per week and 50 weeks per year. Mechanical, 0.927 cent,[1] Electrical, 0.866 cent.[1]

Note—Coal cost based on 2 pounds per indicated horse-power, $1.81 per ton, 56 hours per week, 50 weeks per year.

[1 Editor's Notes.—The author's figures, in English money are: mechanical, 0.445*d.*; electrical, 0.415*d.*]

mill profits have been very satisfactory and every spindle that could be run has been in useful employment.

Mill-owners are coming more and more largely to recognize that a supply from a central authority is a good thing from their point of view. In the case of a new mill, they save a large amount of capital expenditure; in the case of an old mill, whose power plant requires overhauling, they get all the advantages of an electric drive without any further large capital expenditure.

There is therefore little doubt that developments along this line are bound to be fairly considerable, and it would seem to be likely that eventually the generating stations of nearly all the cotton manufacturing towns of Lancashire will have a considerable demand from the textile factories within their areas.

In negotiating for a supply of power with the mill authorities it is necessary to remind them that when due allowance is made for interest, depreciation, maintenance, rates, insurance, etc., the actual power cost in Lancashire, where coal is fairly cheap, is from three to three and a half times the fuel bill. The example given in Schedule II showing how this works out may be of interest.

A number of the mill-owners would, of course, contend that seven per cent depreciation is too high an amount to allow, but when times are good they usually allow more than this themselves, though when trade is not satisfactory depreciation amounts are much lower.

I regret that there is a considerable absence of definite figures, which it would be desirable to give in a paper of this character, but it will be understood that while individual manufacturers are prepared to give figures in confidence, they object to having them generally disclosed, and although this objection will in some cases cease to exist before long, it is at the present moment impossible to give detailed statements publicly.

It is absolutely necessary that a subject such as this should be approached as far as possible in the spirit of research, and it should also be recognized that a very great responsibility rests upon those engineers who, through rashness in approaching a subject on which they have not much information, or through carelessness in the laying out of an installation, get electrical driving a bad name. One unsatisfactory installation does more damage than twenty good ones can rectify, and there are bound to be more or less hostile critics who will be only too pleased to expatiate upon any unsatisfactory results that can be pointed to.

There is still a great deal to be learned as regards the subject, but if due care is taken over the carrying out of future schemes there is little doubt that it will not be many years before every new mill built in Lancashire will be electrically equipped, and it is also equally certain that these mills will be able to make a profit when a good many others can not do so.

Exhibition Committee of the National Electric Light Association.

At the Washington convention of the National Electric Light Association, last June, the Class "D" members (manufacturers) of the association made a most attractive exhibition of electrical apparatus and appliances. During the convention these exhibitors got together and offered to relieve the association of the troubles and responsibilities connected with the organization and maintenance of such exhibits at the annual conventions. The executive committee of the association approved a plan whereby the Class "D" members were to recommend annually an exhibition committee of Class "D" or "E" members. This committee, upon recognition by the president, would elect its own chairman and organize to conduct the work pertaining to manufacturers' exhibits at the convention.

A nominating committee was formally appointed, consisting of George F. Porter (chairman), Atlantic Insulated Wire Company; T. G. Whaling, Westinghouse Lamp Company; Alex Henderson, American Circular Loom Company.

The ticket presented by this committee to the Class "D" members has been approved by a mail ballot of these members and accepted by Dudley Farrand, president of the association. This committee, known as the exhibition committee, is as follows: F. H. Gale, General Electric Company; J. C. McQuiston, Westinghouse Companies; W. S. Heger, Allis-Chalmers Company; Rodman Gilder, Crocker-Wheeler Company; H. M. Post, Western Electric Company; C. P. Frey, Weston Electrical Instrument Company; Benjamin Wall, Metropolitan Engineering Company; James I. Ayer, Simplex Electrical Company; S. E. Doane, National Electric Lamp Association.

On December 6 the committee met in the association rooms in New York and elected F. H. Gale chairman.

A committee on by-laws and rules for governing the committee was appointed and preliminary plans regarding the convention next June were discussed. The actions of this committee are subject to the approval of the executive committee of the association. It will cooperate fully with the president and other officers in making arrangements for the convention.

Federal Civil Services Examinations.

The United States Civil Service Commission announces an examination on January 15, 1908, to secure eligibles from which to make certification to fill vacancies in the position of electrical assistant in the Signal Service at Large at $900 per annum each, with prospects of promotion to $1,400 per annum, and vacancies requiring similar qualifications, as they may occur in any branch of the service. The age limit is twenty years or over on the date of examination. This examination is open to all citizens of the United States who comply with the requirements. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 1,312.

Another examination will be held on the same day to secure eligibles from which to make certification to fill a vacancy in the position of lampist and electrician, $1,000 per annum, in the Custom-House Building, St. Louis, Mo., and vacancies requiring similar qualifications as they may occur in the Custodian Service throughout the United States. The age limit is eighteen to fifty-five years on the date of examination. All honorably discharged United States soldiers and sailors of the War of the Rebellion will be admitted to this examination without regard to the maximum age limit. This examination is open to all citizens of the United States who comply with the requirements, but, at the request of the Treasury Department, preference in certification may be given to legal residents of the county, including the city, in which the vacancy exists. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 1,052.

The commission also announces an examination on January 8, to secure eligibles from which to make certification to fill a vacancy in the position of first-class steam engineer, at $1,200 per annum, in the Custodian Service, at Omaha, Neb., and vacancies requiring similar qualifications as they may occur elsewhere in that service, at salaries ranging from $1,200 to $1,600 per annum. The age limit is eighteen to fifty-five years on the date of examination. All honorably discharged United States sailors and soldiers of the War of the Rebellion will be admitted to this examination without regard to the maximum age limit. Applicants should apply at once for application Form No. 1,052.

THE RATIO OF HEATING SURFACE TO GRATE SURFACE AS A FACTOR IN POWER-PLANT DESIGN.[1]

BY WALTER S. FINLAY.

Power-plant design, in its modern development, is controlled solely by the specific application of general laws modified and molded to suit special requirements. To attempt the construction of a comprehensive ruling from the results of a particular line of investigation in some particular plant, and then to advise the general use of such ruling as conducive to economical operation, would cause confusion, possibly resulting in a wholesale rejection of the good with the bad. However, the value of specific results and their publication lie in the opening up of a

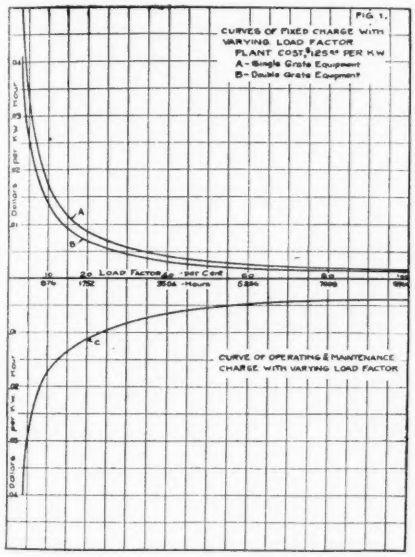


FIG. 1.
CURVES OF FIXED CHARGE WITH VARYING LOAD FACTOR
PLANT COST, $125.00 PER K.W.
A - Single Grate Equipment
B - Double Grate Equipment
CURVE OF OPERATING & MAINTENANCE CHARGE WITH VARYING LOAD FACTOR

FIG. 1.—CURVES SHOWING FIXED CHARGE AND OPERATING AND MAINTENANCE CHARGE WITH VARYING LOAD FACTOR.

line of technical thought, or in adding information to some subject, from which specific deductions or particular application may be made.

The results obtained in the investigation which was primarily the foundation of this paper, should be looked upon merely as specific, but whose bearing upon the general subject by means of a general development, may be of value, particularly in certain new phases of plant design.

As a fundamental and almost initial point of attack in the comprehensive subject of steam power-plant design, the ratio,

$$\frac{\text{heating surface}}{\text{grate surface}}$$

has been a value fixed from the beginning of results of commercial usage, and the expression of the same in empirical formulas or figures suited to the requirements of this or that designer, builder, or manufacturer.

A summation of practice from early engineering times to values developed by the most modern idea, gives a great range to this ratio; namely, from the extreme value as advised by Dalton in 1839 of ten to one, to modern values up to seventy to one used, not only in locomotive, but even in power-plant practice. Of course, the primary object in view has already been the adaptation of values to produce the maximum useful effect; but the question now arises as to whether or not "maximum useful effect" is not being interpreted as maximum economical efficiency with reference to fuel only, as a primary consideration, and with an undue subordination of total plant costs. By total plant costs are meant, of course, the combined fixed charges resulting from interest on plant investment, depreciation, taxes, etc., and operation and maintenance charges.

Properly to investigate the subject in its particular applications would require an extremely tedious and complicated study of innumerable individual requirements; but for a general survey assumptions based upon commonly accepted values will suffice to direct the attention to the point involved.

Assuming a plant first cost of $125 per kilowatt; equipment, including turbo-generators, boilers equipped with stokers, with, say, sixty to one ratio, the following relative costs may be assumed:

Total cost per kilowatt.....	$125.00	100.00%
Building per kilowatt.....	43.75	35.00%
Boilers per kilowatt.....	6.875	5.5 %
Grates per kilowatt.....	1.75	1.4 %
Piping per kilowatt.....	5.625	4.5 %
Coal-handling apparatus per kilowatt	2.30	1.84%
Balance of equipment.....	64.70	

The value of the building as assumed might be considered low, particularly in the case of a turbine plant; boiler cost is possibly average; grates high—a stoker valuation; piping value is about average.

Assuming as a fair value for determining fixed charges: interest on investment, five per cent; depreciation, six per cent; taxes and insurance one per cent, then the total fixed-charge rate would equal twelve per cent.

Upon bases of load-factor and charges, a curve has been drawn showing the relative value of the fixed charges over a range of factor variation from approximately three per cent to one hundred per cent, in the case of the plant as assumed. (Curve A, Fig. 1.)

To determine total charges, the variation of maintenance and operation charges, relative to load-factor, must also be considered. It is rather difficult to assume this curve, as conditions in this respect vary rather widely. However, Curve C, Fig. 1, has been drawn through points located by comparative results obtained in actual cases of operation. The shape of the curve will practically be constant for any figure which may be assumed, and its relation to the general results will be such that the value of the principle involved will be unaffected. The sum of the ordinates between the two curves gives total charges per kilowatt-hour.

In a reconsideration of the plant design as affecting first cost, the natural method

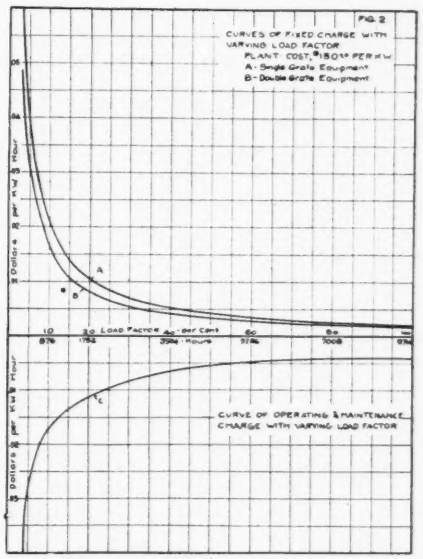


FIG. 2
CURVES OF FIXED CHARGE WITH VARYING LOAD FACTOR
PLANT COST, $180.00 PER K.W.
A - Single Grate Equipment
B - Double Grate Equipment
CURVE OF OPERATING & MAINTENANCE CHARGE WITH VARYING LOAD FACTOR

FIG. 2.—CURVES SHOWING FIXED CHARGE AND OPERATING AND MAINTENANCE CHARGE WITH VARYING LOAD FACTOR.

of procedure is to consider separately each item involved.

1. Building—In turbo-generator plant design, it is a generally accepted rule that total plant dimensions are controlled by boiler-room dimensions; that, for instance, a diminution in the actual size of the boiler room may be accompanied by a proportional diminution in the size of the turbine room, the output remaining the same. The methods of accomplishing such results are perhaps various: change in size of units, difference in type, closer grouping of units, etc.

2. Boilers—The consideration of this feature is naturally interlinked with the subject of grates, and the two can better be discussed together.

Rules of boiler-practice have been derived chiefly, if not entirely, by experiment and investigation; and those rules vali-

[1] A paper presented at a meeting of the American Institute of Electrical Engineers, New York, December 13, 1907.

dated only by general acceptance can be quoted as bases for argument. Such a law is the following one:

All other conditions remaining constant, capacity developed is, with slight modifications, in direct ratio to the area of the active grate surface. An increase in capacity—heating surface remaining constant—caused by an increase in grate area is accompanied by a loss in economical evaporation, due to the increased temperature of the escaping gases.

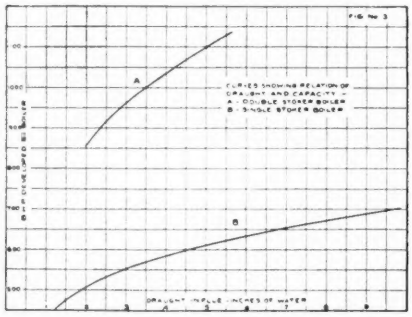


FIG. 3.—CURVES SHOWING RELATION OF DRAFT AND CAPACITY.

This loss in economy is the fundamental factor which must necessarily be the object of a careful study, involving the complete investigation of the heat interchanges taking place in a boiler. The research work of such men as Newton, Péclet, Joule and Rankine, together with recent investigation, has not as yet produced sufficiently definite and authoritative results which may be used as bases of rational calculation in this regard. Under normal conditions of present boiler-practice, estimates of loss vary from practically zero to as much as fifteen per cent fuel economy for an increase of one hundred per cent in boiler capacity.

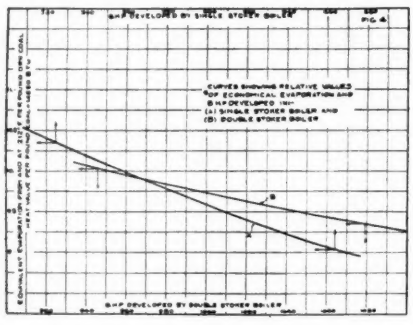


FIG. 4.—CURVES SHOWING RELATIVE VALUE OF ECONOMICAL EVAPORATION AND BRAKE-HORSE-POWER DEVELOPED.

Lately, however, the opinion has been advanced that considerable increase in capacity can, without great sacrifice in economy, be obtained by proportional increase in grate area. This idea is based upon the possibility that combustion and heat distribution and transfer could be much improved under the new conditions, when in increasing the grate area careful attention is given to details of design most conducive to these features. Other conditions being favorable, and with a belief in the correctness of this theory, a change was made in the design of eighteen of the boiler furnaces in the Fifty-ninth street (New York) plant of the Interborough Rapid Transit Company (see Fig. 7). Such a design gave the possibility of operating within the range of the original single-stoker boiler together with the higher range of the double stoker.

The second stoker installed, that is, the one beneath the mud-drum as shown in Fig. 7, has an area of eighty per cent of that of the original stoker. Certain features in the construction of the plant prevented installation of a larger size. A detailed description of points in the design is unnecessary, save to call attention to the fact that the lower stoker is constructed practically within a so-called "Dutch oven," and whatever is conducive to good combustion is provided for therein. The curve shown on Fig. 8 is given as corroborating this fact. Operation of these stokers has shown that such is practically done with but little more complication than existed in the single type.

Tests to determine the comparative economical operation of the double and single stokers show results as given graphically in Figs. 3, 4, 5 and 6. The curves in Figs. 3 and 4 are self-explanatory. Fig. 5 shows a curve plotted upon the values as determined by curves in Fig. 4, this curve being indicative of the fact that operation with the double type was as economical in fuel values as the single type increased in boiler capacity approximately seventy-one per cent. In the curves in Fig. 6 is shown the fact that the economical loss for an increase in rating of eighty per cent as proportioned to the increase in grate area, varied between two and three per cent.

To Summarize the Results of These Tests—It has been made evident that in this particular case double-stoker operation covers the entire range of single-stoker operation and adds an increase of capacity proportionate to its larger grate surface with but slight loss in economy, and that the increase of seventy-one per cent in capacity was accomplished with no loss in economy.

With these results as a basis, let it be assumed that boiler capacity is increased in ratio to increase in grate surface with but little loss of economy. This view might be further strengthened when consideration is taken of the possibilities of economizer practice, the increase in saving, by proper design, being high in ratio to extra cost involved.

To return to the consideration of the items under the power plant whose first cost has been assumed to be $125 per kilowatt, the next point is:

Piping—In the case involved the cost of steam piping between boilers and manifolds, plus boiler-feed piping, plus boiler blow-down piping, has alone been considered. With any change in number of boilers, capacity remaining the same, the cost of piping will vary in the same ratio times a factor due to change in size of pipe.

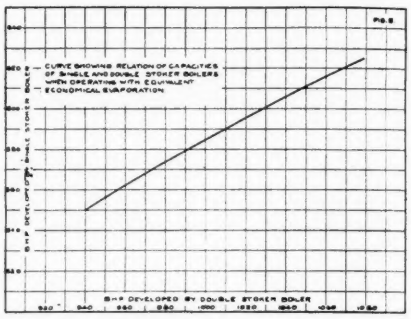


FIG. 5.—CURVE SHOWING RELATION OF CAPACITIES OF SINGLE AND DOUBLE-STOKER BOILERS WHEN OPERATING WITH EQUIVALENT ECONOMICAL EVAPORATION.

Coal-handling Apparatus—Fixed plant capacity would seem to demand fixed cost of coal-handling apparatus, but the proportionate value of the conveying apparatus is so large that when any change is made affecting the length of carry the total system cost will be raised or lowered, although not in direct ratio to such change.

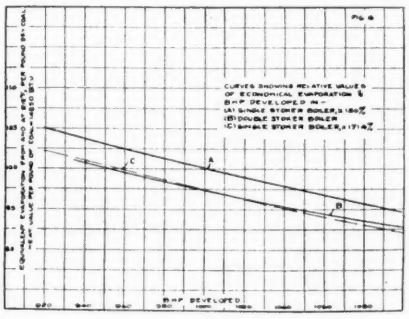


FIG. 6.—CURVES SHOWING RELATIVE VALUE OF ECONOMICAL EVAPORATION AND BRAKE-HORSE-POWER DEVELOPED.

Effect of Change of the Ratio of Heating Surface to Grate Surface—Suppose that in a reconsideration of the plant design it is decided to cut in half the ratio of heating surface to grate surface by the use of double grates or stokers under boilers of the same rating. Plant output is to remain the same. A tabulation of the costs as revised would be as follows:

	Per Kilowatt.
Building (reduced 40%)	$26.25
Boilers (reduced 50%)	3.438
Stokers (remain same)	1.75
Piping (reduced 40%)	3.735
Coal-handling apparatus (reduced 15%)	1.955
Balance (remains same)	64.70
	$101.468

A curve (B, Fig. 1) is plotted upon this new basis.

Operation.		
Water tenders	20.82	10.41
Stoker operators	38.09	38.09
Assistant stoker operators	15.49	15.49
Stoker oilers	2.54	2.54
Economizer oilers and cleaners	5.84	2.92
Boiler feed-pump men	5.08	5.08
Boiler cleaners	10.41	5.21
Miscellaneous labor	1.73	1.73
Total	100.00	81.47

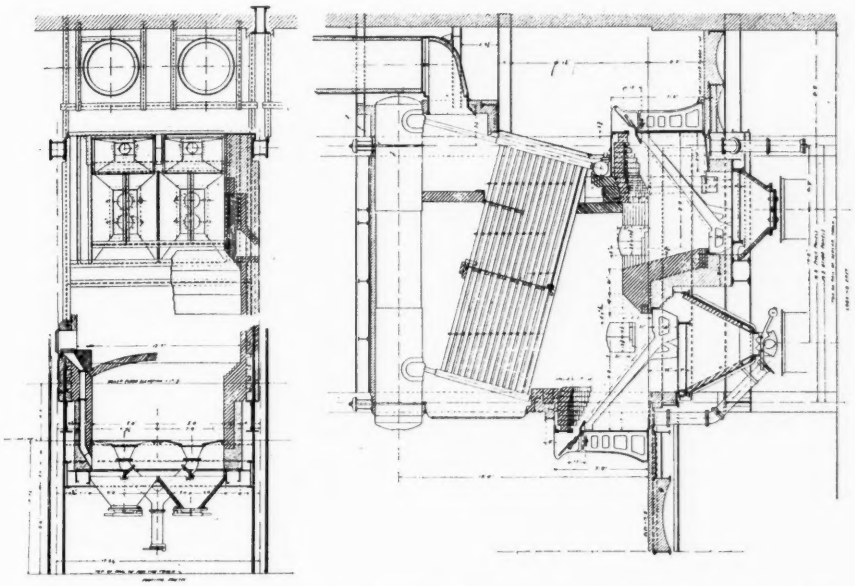


FIG. 7.—ARRANGEMENT OF THE DOUBLE STOKER BOILER SETTING AT THE PLANT OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

Summation—Plant first cost and fixed charges, each reduced 19.6 per cent.

The next consideration is that of the effect of such changes upon plant maintenance and operation charges. Properly to discuss this the following tabulation, based upon the figures given by H. G. Stott in his paper on "Power Plant Economics,"[1] will furnish a means of comparison:

Maintenance.	Single Grate. Per Cent.		Double Grate. Per Cent.
Engine room, mechanical	0.64		0.64
Boiler room	5.40	— (16) =	4.54
Coal and ash handling apparatus	0.68		0.68
Electrical apparatus	1.41		1.41
Operation.			
Coal and ash handling labor	2.65		2.65
Removal of ashes	1.18		1.18
Dock rental	0.93		0.93
Boiler-room labor	8.38	— (18.5) =	6.83
Boiler-room oil, waste, etc.	0.21		0.21
Coal	71.94	+ (3) =	74.10
Water	0.90		0.90
Engine-room mechanical labor	1.70		1.70
Lubrication	0.44		0.44
Waste, etc	0.38		0.38
Electrical labor	3.16		3.16
Total	100.00		99.75

The saving in boiler-room maintenance and operation may be accounted for in the following itemized statement of boiler-room charges:

Maintenance.	Cost. Single Grate Per Cent.	Double Grate. Per Cent.
Boilers	29.5	14.75
Economizers	2.78	2.78
Furnaces	17.29	17.29
Stokers and stoker engines	40.68	40.68
Boiler feed-pumps	5.42	5.42
Boiler feed-piping	2.20	1.10
Boiler blow-off piping	0.44	0.44
Water-supply piping	1.52	1.52
Total	100.00	83.98

[1] Transactions of the American Institute of Electrical Engineers, Vol. XXV., p. 1.

Thus with changes as noted the decrease in maintenance and operation would be 0.25 per cent, the curve for same practically coinciding with Curve C, Fig. 1.

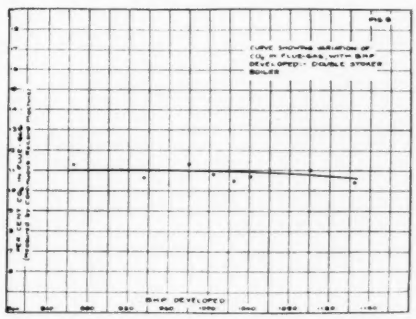


FIG. 8.—CURVE SHOWING VARIATION OF CO_2 IN FLUE-GAS, WITH BRAKE-HORSE-POWER DEVELOPED.

A second set of curves, based upon a plant cost of $150 per kilowatt, as shown in Fig. 2.

Plant cost per kilowatt	$150.00	100.00%
Building	60.00	40.00%
Boilers	8.25	5.5 %
Stokers	2.25	1.5 %
Piping	6.75	4.5 %
Coal-handling apparatus	2.63	1.75%
Balance	70.12	
Same plant, double stoker.		
Building (reduced 40%)		$36.00
Boilers (reduced 50%)		4.13
Stokers (remain same)		2.25
Piping (reduced 40%)		4.05
Coal-handling apparatus (reduced 15%)		2.24
Balance		70.12
Total		$118.79

Showing a reduction in first cost and fixed charges of 20.8 per cent.

Summary—In the case of the $125 plant the following savings might be effected by use of double grate:

First cost, 19.6 per cent saving.

Total plant charges varying from a saving of 5.64 per cent at 100 per cent load factor to 7.54 per cent at 50 per cent factor to 9.65 per cent at 4.16 per cent factor (365 days per year).

In the case of the $150 plant.

First cost, 20.8 per cent saving.

Total plant charges vary from about 7.06 per cent saving at 100 per cent load factor to 9.26 per cent at 50 per cent factor to 11.51 at 4.16 per cent factor.

Thus summarized, the remarkable effect that the grate area and heating surface ratio, when furnace design is carefully considered, may have upon plant first cost and total annual costs should certainly place this particular feature well up in the list of subjects for careful investigation, and make it a point of primary and fundamental consideration in advanced design.

Arthur Williams Honored.

Arthur Williams, general inspector of the New York Edison Company, has had conferred on him by the French Republic the decoration of Officier de l' Instruction Publique. The decoration was presented to Mr. Williams at the Engineers' Club on December 18, at which time a luncheon in his honor was tendered by his colleagues on the board of the American Museum of Safety Devices and Industrial Hygiene and several other friends. There were some sixty gentlemen present, including the members of the board, officers of the New York Edison Company, and a number of gentlemen eminent in electrical circles. The decoration was presented to Mr. Williams by Dr. W. H. Tolman, representing the French Republic, and addresses were made by Dr. Josiah Strong, president of the American Museum of Safety Devices and Industrial Hygiene; John W. Lieb, Jr., associate general manager New York Edison Company, and T. C. Martin, president of the Engineers' Club. Mr. Williams responded gracefully to the honor and stated that his efforts in public work, through his writings and the duties of his position, had always received the warm cooperation of his associates in the New York Edison Company.

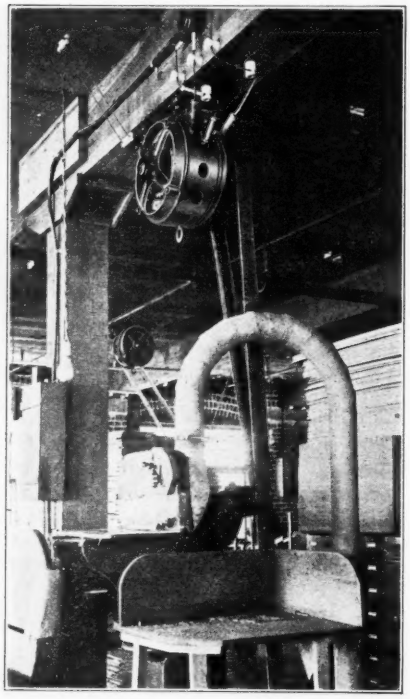
Among the gentlemen present at the luncheon, in addition to those named, were: Walter C. Kerr, N. F. Bradv, Thomas E. Murray, Dr. W. M. Habirshaw, R. W. Gilder, Charles W. Price, H. W. Blake, F. E. Rogers and A. A. Hopkins.

The object of the American Museum of Safety Devices and Industrial Hygiene is to direct the attention of the American public to the necessity of doing something to lessen the causes of accidents to life by means of a permanent exposition of safety devices where all problems of safeguarding life and limb can be studied in their working details.

ELECTRIC DRIVE IN A WOOD-WORKING PLANT.

BY C. A. TUPPER.

An interesting example of the economies and other advantages effected by the introduction of electric drive in a wood-working plant is afforded by a visit to the works of the Mears-Slayton Lumber Company, manufacturers of pine, hemlock and hardwood lumber, sashes, doors, interior finishings, etc., whose main offices, factory and yards are at 1103-1113 Belmont avenue, Chicago, extending back some distance from the street. The newer portion of the plant has been equipped with a full line of induction motors, built by the Allis-Chalmers Company, of Milwaukee, Wis., whose engine and electric generators

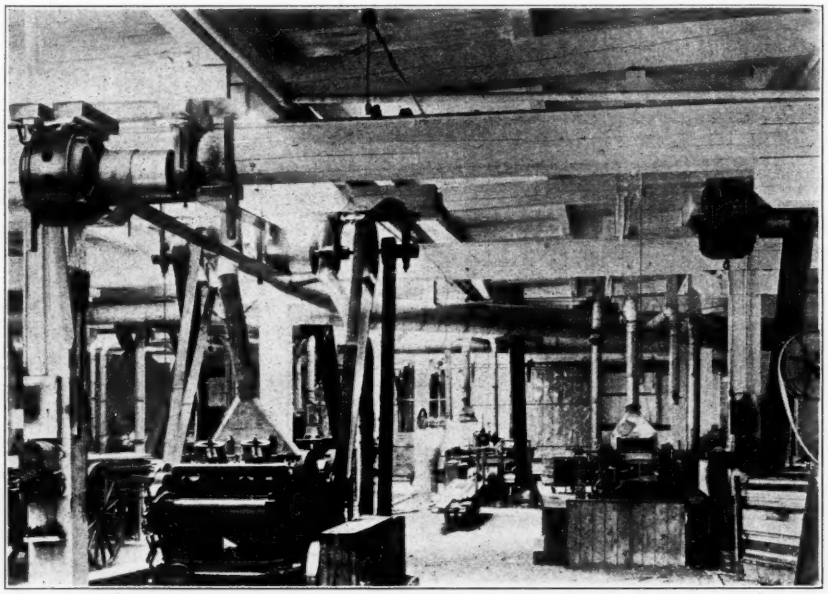


TWO-HORSE-POWER INDUCTION MOTOR BELTED DIRECT TO TENONER.

are also here installed, and the same system will gradually be extended throughout the establishment.

The first impression made upon a visitor entering the new shop, where electric drive has been introduced, is that of light, cleanliness, order, clear head-room and the dispatch with which the work is conducted. And that the last-named is no mere "impression" may be seen from the statement of Robert Slayton that, since the motors were put in operation, the daily capacity of the plant has increased fully twenty-five per cent per day.

The machine to be first seen, upon entering, is a sixteen-inch sticker, built by the S. A. Woods Machine Company, which is operated by a twenty-horse-power motor. The details of this arrangement are clearly shown in the accompanying illustration. It will be observed that the spaces above and around the machine are open, not only allowing the operatives to

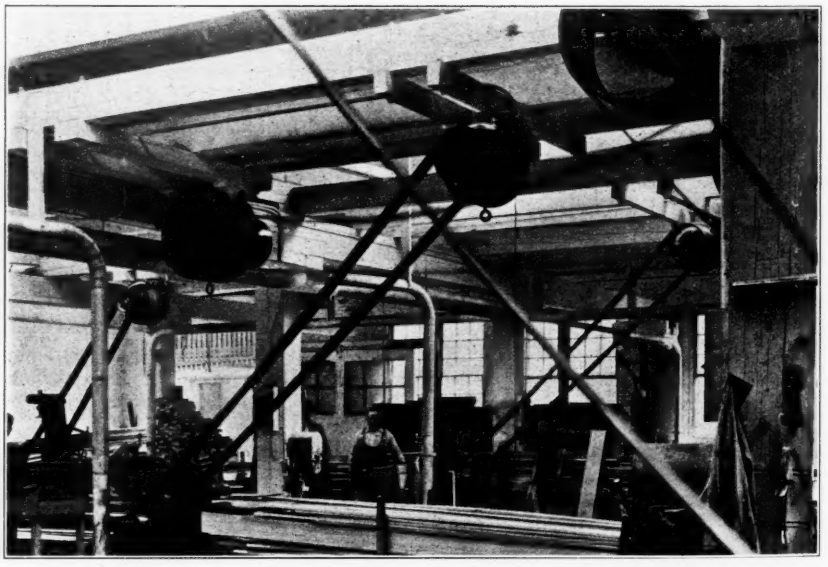


VIEW IN PLANT OF MEARS-SLAYTON LUMBER COMPANY, CHICAGO, ILL. TWENTY-HORSE-POWER INDUCTION MOTORS, ONE (AT RIGHT) DRIVING SIXTEEN-INCH STICKER, AND THE OTHER DRIVING THIRTY-INCH SURFACER.

take advantage of the excellent lighting, but also giving much additional floor space for the piling and handling of the rough and finished material. This is not the least valuable consideration in a plant where the products are inevitably bulky and cumbersome.

Back of this is a thirty-inch by twelve-inch double surfacer, furnished by the Berlin Machine Works, of Beloit, Wis., which is also driven by belting from a twenty-horse-power motor. A special feature of this surfacer is the arrangement of the feed rolls. While only four are used, the pulling is greater than on the ordinary six-roll machine. Four speeds of feed are furnished, *viz.*: forty-four, forty-nine, fifty-three and seventy feet per minute. A tight and loose pulley, sixteen inches by eight inches, is used.

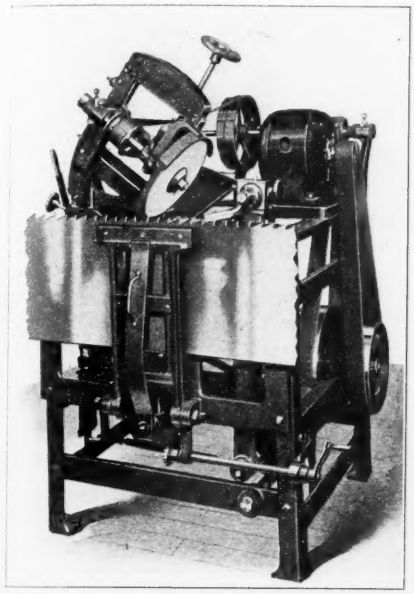
At the right of the surfacer is a Berlin



INDUCTION MOTORS DRIVING COMBINATION BAND AND RIP-SAWS AND SWINGING CUT-OFF SAWS.

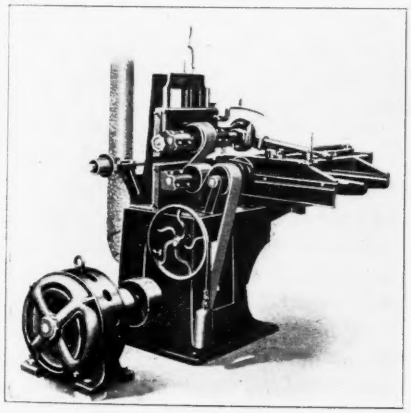
combination band rip and resaw, belted directly from a twenty-horse-power motor. This machine, which lends itself particularly to the advantages of electric drive,

can be quickly changed from a resaw to a rip-saw, or *vice versa*. It is used for all kinds of resawing within its capacity of fourteen-inch width and sixteen-inch thickness, for which purpose it has practically all the advantages of any vertical band resaw made. In addition, the construction of the feed roll is such that a



INDUCTION MOTOR DRIVING BAND SAW SHARPENER.

thick cant or plank may be resawed into thin lumber without any adjustment. A variable friction feed is used, having a range of twenty-four to eighty feet per minute for resawing, and forty to 200 feet per minute for ripping. The driving pul-



SINGLE-END TENONER DRIVEN BY INDUCTION MOTOR.

ley is twenty inches in diameter by six and one-half-inch face.

Placed in various corners of the room are seven Berlin swinging cut-off saws, some of which are shown herewith, each belted to a three-horse-power motor, and near one end are two twelve-inch Greenlee rip-saws, each driven by belting from a ten-horse-power motor.

For cutting off all lengths and kinds of rough lumber or timber, motor-driven swing-saws are rapidly coming into favor. In fact, they have become almost a necessity, not only in wood-working shops, but to contractors generally, as they combine simplicity, accuracy and convenience. The frame of each of the saws above mentioned is cast in one piece, of the best design to insure rigidity and strength, cored for lightness and counterbalanced by a weight for easy operating. It swings on turned extensions of the hanger bearings. Saws up to thirty-inch diameter are used.

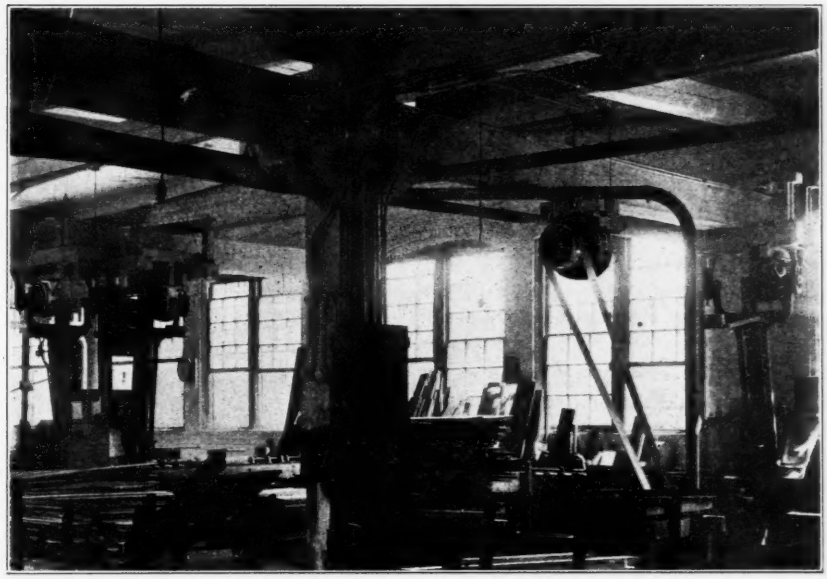
The motor-driven, self-feeding rip-saw tables furnished by Greenlee Brothers & Company are of particular value because of the variety of work to which they can be applied. Each machine is driven by a belt from the motor pulley to the saw arbor pulley. This is the only external belting and the saw arbor is fitted with a three-step cone pulley directly beneath the table; the belt runs from this cone pulley to a lower shaft and then to the top feed works. The feed, therefore, is controlled directly from the saw arbor. The material is fed from the front into the forward feeding spur and this spur feeds the stock through the saw, and a roll at the rear of the saw feeds the stock away after it has been ripped.

The reader's attention should be directed to the position of this and other motors shown in the illustrations. By shifting the housings of these induction motors through ninety degrees, or 180 degrees, so that the oil-cups are placed in their proper relation to the shaft, they are easily adapted to side-wall or ceiling mounting, which is ordinarily the most convenient arrangement in a wood-working shop.

A hand-feed rip-saw of the Mears-Slayton Lumber Company's own design takes its power from a five-horse-power motor, and is found very useful for certain classes of work.

In the centre of the plant is a short line of shafting driven by a fifty-horse-power motor, from which are belted fourteen-inch and nine-inch Hermance stickers, eight-inch S. A. Woods Machine Company's stickers and a six-inch sticker built by the H. B. Smith Machine Company.

The Hermance stickers, or molders, show a number of important improvements, the use of which is facilitated by electric drive, among them being the so-called "wide-open" feature. This consists of throwing the shaving hood and chip breaker back across the machine; the hinged pressure bars turning upward and the rear table beyond the lower head dropping, thus allowing free access to all cutter heads, for setting, sharpening or adjusting the knives. In front of the two top feed rolls there is a lever, which allows the operator to raise his rolls off the work whenever desirable, and a "double-quick" adjustment of the side-heads, by which much time is saved. The other stickers mentioned also possess special advantages for the work to which they are applied. The Hermance machines, including a "double-power" combination saw table, also an endless double-bed surfacer, built by E. & B. Holmes, Buffalo, N. Y.,



INDUCTION MOTORS DRIVING SWINGING CUT-OFF SAWS AND HAND-FEED STATIONARY RIP-SAWS.

were supplied by the Chicago Machinery Exchange.

All sawdust and shavings are effectually removed from the machines, freed from dirt and carried to the furnaces by a system which includes an eighty-inch American blower driven by a forty-horse-power motor. This is a right-hand, top vertical-discharge fan, fitted with a long shavings wheel. The pulley is fourteen inches in diameter by ten and one-half-inch face. The unit is run at 850 revolutions per minute, giving three-ounce pressure and delivering approximately 24,000 cubic feet of air per minute. Exhaust pipes are also led directly to the floor, so that by simply opening a damper sweepings in the openings are carried away. Refuse wood is collected and sold for kindling to householders in the vicinity.

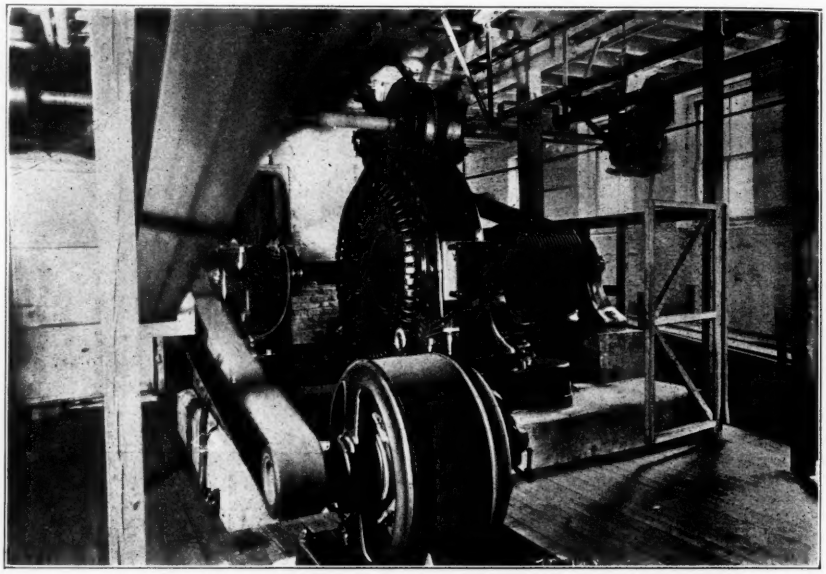
In the tool room two automatic saw grinders are motor driven, as are also an automatic band rip-saw grinder, emery wheel and other tools. As each of these is used for occasional short periods only, the power required here is practically negligible as compared with what would be needed for shafting.

One feature which gives particular satisfaction to the owners of the plant is the saving in power effected by means of electric drive, which they find to be very considerable. When machines are not in use they of course take no current from the wires, and the load is thus distributed only where it is absolutely needed at the time, thereby enabling the entire system to be operated on only a fraction of the power that would be required for shafting continuously run. While the power necessary for operating this portion of the plant, with all machines running, is 150 horse-power, the average pull from the generator does not exceed seventy horse-power, and occasional overloads are easily taken care of; no specific provision had to be made for the latter in determining the size of the power plant, as would be the case where line shafting is used.

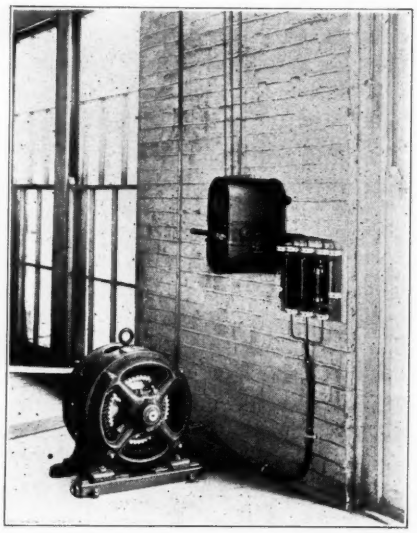
In addition to the motors mentioned above, others are reserved for use in the yards, where they may be located at any point convenient to the work, which is principally the operation of rip-saws, conveyors, etc. This illustrates one of the advantages of the electric system, *viz.*: its great flexibility and the ease with which power generated at a central plant—frequently located some distance from the work—can be applied to any purpose required. Induction motors, such as those furnished by the Allis-Chalmers Company for the Mears-Slayton Lumber Company, are adapted to distance control and can be installed and operated even in places not readily accessible.

Among the machines on the ground floor of the old shop are a sixty-inch Berlin sander, belt driven, which takes twenty-five horse-power; a panel planer, manufactured by Frank H. Clement, Rochester, N. Y.; panel sanders and panel raisers, built by the American Wood Working Machinery Company; a turning lathe, purchased from the same concern, and a fifty-inch Garden City blower, the last named being direct connected to a twenty-five-horse-power motor. About 150 horse-power is used here and on the three floors above, which are filled with lighter tools. The sixteen-foot elevator is run by a motor of ten horse-power.

Among the electrically driven machines not already mentioned are tenoners, spindle shapers, additional rip-saws, a twenty-four-inch pony planer, emery grinder, large band saw and various accessory apparatus, operated by motors ranging in size from two to fifteen horse-power. The main factory is a three-story building, with basement, and larger sheds at the rear for lumber storage. The dry kiln is housed in a separate structure. Fire protection is carefully provided for, a sprinkler system being installed throughout the shops. Steam is generated in three Erie boilers, placed over furnaces of a special design, built by George Gulickson, of Chicago.



225-Kilowatt, Three-Phase, 480-Volt, Alternating-Current Generator Connected by Rope Drive to Allis-Chalmers Engine, also Nine-Kilowatt Exciter, Mears-Slayton Lumber Company, Chicago, Ill.



Standard Type "N" Induction Motor and Starter.

The prime mover is an eighteen-inch by forty-two-inch Allis engine, with a fourteen-foot flywheel ground for seventeen ropes, from which an Allis-Chalmers alternating-current generator (with belted exciter of the same company's build, which also runs the lights) is driven.

From the generator electric current generated at 440 volts, three-phase, sixty-cycle is carried; well-insulated wires run through iron conduits (grounded by wires leading to the nearest water pipe) to a distributing switchboard in the new shop, whence the motor circuits branch off to the various departments. With each motor is installed one of the Allis-Chalmers Company's potential starters, which are practically "fool-proof," inasmuch as they are so arranged that it is impossible to throw them from the off to the running position

without first passing through the starting position.

Induction motors are, in all respects, the best type of machine for general power distribution on alternating-current circuits, and they have special advantages for operation in planing mills, wood-working plants, etc., having no moving electrical contacts and consequently causing no fire risk. They also start under load, run at approximately constant speed, regardless of load, and if the load is suddenly thrown off no racing can occur. They are extremely simple in construction, having no commutator or brushes, and this, as above intimated, insures absolute freedom from sparking, flashing or burning. The voltage in the rotating part is so low that insulation breakdowns do not occur. Furthermore, an induction motor, when started, does not require synchronizing, and on account of its simple construction and absence of all auxiliary devices, except starters, the cost of maintenance and attendance is less than for any other type of electric motor.

Notwithstanding the fact that the plant of the Mears-Slayton Lumber Company represents an accretion, or the addition of one part after another, the flexibility of operation brought about by the use of electric power in the new shop has given them practically the advantages of the unit system. Raw material brought in at the rear is cut, planed, molded, sanded, etc., and progresses by various stages to the completed products of the company and is loaded for shipment without any retrogression or unnecessary handling.

The plant is located where excellent transportation facilities are available, enabling customers in an extensive and thickly populated territory to be quickly reached by any of the roads centering at Chicago, and the local trade of the Mears-Slayton Lumber Company is also very large.

American Society of Mechanical Engineers.

The next monthly meeting of the American Society of Mechanical Engineers will be held on Tuesday evening, January 14, in assembly room No. 1 of the Engineering Societies Building, New York city. The subject will be "Car Lighting," the paper to be presented by R. M. Dixon, president of the Safety Car Heating and Lighting Company. The paper will treat of the general subject of lighting of trains, showing the relative economies in the electric and gas systems. There will be demonstrations of several methods, such as the Pintsch mantle, the vapor-mantle system, a new acetylene system and several varieties of gasolene lighting by electricity, with regulating and governing mechanisms.

American Association for the Advancement of Science.

The annual meeting of the American Association for the Advancement of Science will be held December 30 to January 4, at the University of Chicago, Chicago, Ill. The first session will be held on Monday morning, December 30, after the opening session of the association. A joint meeting of Section A, mathematics and astronomy, and Section D, mechanical science and engineering, with the Chicago Section of the American Mathematical Society as an affiliated society, will be held on Monday afternoon, December 30, at 2 o'clock, and on Tuesday morning, December 31, at 10 o'clock, and possibly on Tuesday afternoon.

The Monday afternoon topic will be: "The Present Status of the Teaching of Mathematics to Engineering Students." It will be led by Professor E. J. Townsend, of the University of Illinois, who will speak for America; by Professor Alexander Ziwet, of the University of Michigan, who will speak for foreign countries, and by President R. S. Woodward, of the Carnegie Institution, and Charles F. Scott, consulting engineer of the Westinghouse Electric and Manufacturing Company.

The Tuesday symposium will be on the topic: "What Is Needed in the Teaching of Mathematics to Students of Engineering." It will include (*a*) The Range of Subjects; (*b*) The Extent of the Various Subjects; (*c*) the Methods of Presentation; (*d*) The Chief Aims. It will be discussed from the standpoint of the practicing engineer by Dr. Charles P. Steinmetz, consulting engineer of the General Electric Company; by Ralph Modjeski, consulting civil engineer of Chicago; by W. L. Abbott, chief operating engineer of the Chicago Edison Company, and by J. A. L. Waddell, consulting bridge engineer. It will be discussed from the standpoint of the professor of engineering by Professor Gardner S. Williams, of the University of Michigan, and by Professor Arthur N. Talbot, of the University of Illinois. It will be discussed from the standpoint of the professor of mathematics in the engineering school by Professor Charles S. Slichter, of the University of Wisconsin; by Professor Frederick S. Woods, of the Massachusetts Institute of Technology, and by President Fred W. McNair, of the Michigan College of Mines.

A subscription dinner for engineers and mathematicians will be served on Monday evening at the Hotel Del Prado.

The sessions of the section for the reading of the other papers that will be presented will be held on the afternoon of December 31, and on January 1, 1908.

A new secretary for five years is to be elected at this meeting.

Transportable Form of Standard Cell.

A transportable form of standard cell has been developed by Ralph E. De Lury, at Princeton University, where the author, who here describes his device, has been cooperating with Dr. G. A. Hulett. The idea was to so construct a retaining vessel so that the cell could be transported without being affected; in fact, so that it might be turned upside down and, upon righting, the materials within it would return to their proper positions. The idea used was that which applies to the unspillable ink-wells. The cell is constructed by placing a small glass tube within a larger one, where it is held centrally while a gas flame is directed against the outer tube, and that is rotated until it contracts and welds itself to the inner tube. The tube is then blown out, leaving an intermediate chamber which communicates with the outer ends of the tube through the remaining ends of the smaller tube. One end of the outer tube is sealed up and a platinum wire sealed into it. This forms the bottom of the cell. A second platinum wire is sealed into the annular channel on the other portion of the tube, and the cell is then ready for filling. Mercury is placed in the bottom, covered with the usual depolarizing paste, and over this is poured the sulphate solution filling up the lower chamber. An asbestos or mineral-wool plug is packed into the intermediate chamber, forming a sort of diaphragm. The amalgam is then placed within the annular portion of the upper part of the cell and is covered with the sulphate solution. The upper section may thus be sealed off, leaving an air space to allow for temperature changes, or may be closed by a cork. This cell may be turned end for end, but when righted the mercury at the amalgam will flow back into proper position, the paste will settle down on the mercury and the solution gather at the top. If by accident any of the material should get into the inner tube, by turning the cell upside down and then righting it, it will return to its proper position. This arrangement is suitable either for Clark or Weston cells, while if it be desired to use the H form of cell, the arrangement just described may be introduced in the connecting tube.
—*Physical Review (Lancaster), December.*

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The City Lighting of London.

A summary is given here by H. Harrison of a photometric survey made of a number of streets of London, England. The instrument used was the flicker photometer, and the direct illumination was measured in each case. At the same time this instrument was checked by a screen photometer. The measurements were all taken four feet from the ground and the following streets were surveyed: Cannon street, where there are long-burning flame arc lamps suspended over the middle of the street, twenty-eight feet from the ground, and forty-six lamps to the mile; Holborn Viaduct, lighted with long-burning flame arc lamps erected on alternate sides, twenty-three feet from the ground and forty lamps to the mile; Queen Victoria street, lighted by pairs of high-pressure gas lamps on alternate sides, thirteen feet from the ground and seventy lamps to the mile; Farringden street, lighted by enclosed arc lamps on alternate sides, seventeen feet from the ground and seventy lamps to the mile. The width of the streets varies from fifty to sixty feet between the curbs, with the exception of the last-named, which is wider in places. Curves are drawn showing the actual results obtained in candle-feet and the distances from the lamp. From this it is seen that the lighting of Cannon street is the best, and the maximum direct intensity, half-way between the lamps, exceeds 0.2 candle-foot, whereas on the Holborn Viaduct it is as low as 0.06 candle-foot. In Queen Victoria street the lowest figure is 0.1 candle-foot; in Farringden street it falls as low as 0.04 candle-foot. The minimum horizontal illumination was 0.16 candle-foot for Cannon street; 0.03 for Holborn street; 0.033 for Queen Victoria street and 0.01 for Farringden street. The low minimum illumination in Holborn is due to the low candle-power of the two lamps at the rays approaching the horizontal, and this is accentuated by the low mounting of the lamps. The reason of this bad distribution is not only to reduce the minimum illumination but also to increase the maximum. The excellent illumination of Cannon street is obtained without increase of cost and is due to the correct arrangement of the lamps, which arrangement not only conduces to the comfort of the public by a more uniform illumination, but also by withdrawing from their line of sight the powerful lamps necessary for the purpose.—*Abstracted from the Electrical Review* (*London*), *December* 6.

Electric Arch Illumination.

After the earthquake and fire in San Francisco in April, 1906, many large business houses were driven out of the business section of the city and found new quarters on comparatively quiet Fillmore street. This is a main crosstown highway, but was largely occupied before the fire by small stores. Now that the city is being built up again, the new tenants of Fillmore street have been returning to their old district, but the merchants of Fillmore street wish to retain some of the new business activities. For this purpose an improvement association has been organized, and one of the steps taken by this organization has been to introduce a striking system of illumination in the street. The previous illumination consisted of arc lamps at the street crossings with Welsbach mantles interspersed. To secure something more striking and attractive, a system of arches has been installed at the crossings. Four poles, sixteen feet high, have been erected, one on each corner. From these spring four lattice girder sections which meet in the centre of the crossing. On the girders are placed 120 sixteen-candle-power incandescent lamps, and on the top of the arch is a fifty-candle-power lamp in a white globe. There are thus 1,680 of the smaller lamps on the street and fourteen of the larger. The effect is brilliant and spectacular. The cost of installing the system has been borne by the improvement association, but the city has agreed to pay for the energy used in the lighting.—*Abstracted from the Journal of Electricity, Power and Gas* (*San Francisco*), *December* 14.

The Electric Drive in Iron and Steel Mills.

Two methods which have been devised for driving rolling mills without throwing a too variable load upon the generating station are here described briefly by W. E. Reed, who also describes the equipments of several of the most notable installations of each type. The methods adopted for equalizing the load depend upon the character of the work. Where the rolls run continuously in one direction a flywheel meets the requirements. This is usually placed upon the driving motor, which is specially designed so that the speed will vary considerably with the load in order that the flywheel may give up and absorb considerable amounts of energy. When the rolls are in operation the motor set tends to slow down, thus utilizing part of the kinetic energy of the flywheel; on the other hand, when the load is light the motor generator tends to regain its original speed, and in so doing stores up energy drawn from the supply system. If the mill be of the reversing type the kinetic energy of the driving motor should be small, and some means of storing up energy should be interposed between the driving motor and the supply system. This may be done by placing a motor-generator set upon which is mounted a heavy flywheel, the motor being designed so that its speed will vary considerably with the load of the generator. Among the installations which have been made recently is that at the Edgar Thompson Steel Works, where there are two 1,500-horse-power, compound-wound, 220-volt, 100-125-revolutions-per-minute, direct-current motors directly connected to the rolls. Special attention has been given to the mechanical design of this equipment, as the bearings, of twenty-five inches in diameter and sixty-two inches long, are self-oiling and arranged for water-cooling. An installation of the reversing type has been placed at the Hildegarde Works, in Austria. This mill is driven by a four-bearing set of three direct-current motors. Three units are employed to reduce the inertia. Each motor is rated at 1,200 horse-power and varies in speed from stand-still up to 120 revolutions per minute. Each motor has a maximum output of 3,000 horse-power. They have series and shunt windings which are separately excited; the armatures are connected in series. The equalizer is a four-bearing set consisting of an induction motor, two direct-current generators and two flywheels. Each wheel weighs about twenty-six tons. When reversing this equalizer

acts as a brake, absorbing the energy delivered by the motors, which are then running as generators. The speed of the induction motor is varied automatically by a water rheostat. This equipment is capable of reversing the rolls in six to eight seconds. Another equipment of the reversing type is that at the Illinois Steel Works, where there is a thirty-inch plate mill driven by two 200-horse-power motors. These are direct-current motors, shunt wound, maximum speed 150 revolutions per minute. Commutation is provided for by commutating poles and compensating coils wound in slots in the pole faces. The maximum power taken from the station is approximately thirty per cent of that taken by the mill motor. This mill should be capable of reversing in from four to six seconds.—*Abstracted from the Electric Journal (Pittsburg), December.*

Metallic-Filament Lamps: How Will They Affect Electrical Undertakings?

A rather pessimistic view of the effect which the metallic-filament lamp will have upon the business of the English central station is taken here by the author—a lampmaker. He begins by saying that it is evident that the carbon-filament lamp, with its low efficiencies, is doomed. For a few months, it may be a year or so, it will be used by those who are slow to change, but the metallic-filament lamp has taken its place. It has been argued that the loss due to the new form of lamp would be offset by the increased use of electric lighting; but the author does not think that an examination of the situation bears out this opinion. He thinks it can be demonstrated that sufficient new customers can neither be obtained nor connected to the system at a profit unless radical innovations in systems of charging and connecting are adopted. He says that the eight-candle-power, eight-watt lamp of high voltage is coming, and that this unit will be employed rather than the seventy-candle-power lamp which many central stations now expect to be used. He does not think that the stations can expect to increase the standard size, pointing out as evidence that the high-candle-power gas mantle failed to do so. He thinks that customers will rather rejoice in the reduction of their lighting bills than be pleased with an increased amount of light at the same cost. Many expect that the reduced costs of electric lighting secured through the metallic-filament lamp will lead to a greatly extended supply system. The writer holds that to do this to any extent it will be necessary to carry the distributing into districts which even with present methods would not be profitable. If, then, these districts would not pay when using the carbon lamp, he does not think that they can possibly be expected to pay if the lamp used takes only one quarter of the energy of the old. The writer goes into more detail in this particular part of the question, working out the actual costs for lighting, his conclusion being in agreement with that just expressed. He says, however, with certain innovations and alterations in systems of charging, the lighting systems might be profitable, but he believes that the whole question of electrical supply is about to undergo so great a change that the question of whether a profit is made or whether it merely covers legitimate expenses will have very little effect on the station. Presumably he is anticipating municipal ownership of lighting systems.—*Abstracted from the Electrical Engineer (London), December 6.*

A Comparative Study of Clear and Frosted Lamps.

In the ELECTRICAL REVIEW for April 6, 1907, Dr. Edward P. Hyde contributed a short study of the causes reducing the useful life of frosted incandescent lamps. His conclusion was that the known reduction in the candle-power is due to the increased absorption caused by the layer of carbon deposited on the inner surface of the globe, since frosting causes more reflection of the light than does the plain bulb. These reflected rays pass through this deposit at least three times before they issue from the bulb. Some of them are re-reflected, suffering again from the same effect. These conclusions were borne out by experiments which he made with bare and frosted lamps, and are also in accord with the fact that the frosted lamp does not burn out any sooner than the bare lamp. The fact is merely to reduce the candle-power of the lamp. This study has been continued by Dr. Hyde, and he here contributes a more detailed discussion of the behavior of frosted lamps, having been assisted in this work by T. E. Cady. The author classifies the effect of frosting into three general heads: the change in absorption, the change in distribution and the change in life. Further investigations of the first effect bear out the conclusions previously arrived at, but more specific figures are given of a large number of lamps first photometered bare and then after frosting by either the acid or the sand-blast process; of the different lots of lamps some showed a larger change in the absorption than others. This expression, "change in absorption," is used by the authors rather than the "absorption," because the bare bulb itself absorbs a certain amount of the light; the effect of frosting is to increase this rather than to introduce a new element. The mean value for the change in absorption is found to be 5.7 per cent. This value must not be taken as very accurate, as it may vary one per cent either way. Further, it applies only to the seasoned lamps, and it is a question whether it would be the same for unseasoned lamps. The change in distribution, in other words the change in candle-power in the various directions, due to frosting, is an important feature. Usually it would be assumed that frosting would tend to produce a more uniform distribution of light, but this was not found to be true in all cases. The effect may be shown in another way, that is, by determining the change due to frosting in the spherical reduction factor. It was found that the reduction factor of oval-anchored lamps to be substantially the same before and after frosting, showing no tendency to approach unity, as would be the case if the distribution were made more uniform. The change in the reduction factor for the other types of lamp is small except for the spiral-filament and downward-light lamps. The former shows a decrease in reduction factor of 5.5 per cent and the latter of 3.5 per cent. That is to say, the effect of frosting is to diminish the mean spherical candle-power relatively more than the mean horizontal. Distribution curves, before and after frosting, for the various forms of lamps, are shown. The most notable features of these is the increase in the tip candle-power of the double-filament lamp and the decrease for the spiral-filament lamp. The shape of the bulb is of course an important factor of this effect. This was partially shown by testing a number of special lamps having spherical bulbs. Investigation has developed no reason for changing the previously expressed opinion regarding the effect of frosting on the life of the lamp. In fact, it is difficult to imagine physical reasons for such change, for although the frosted bulb does become hotter than the plain bulb, this increase in temperature is only ten to fifteen degrees centigrade above that of the plain bulb, and can not have any appreciable effect upon the temperature of the incandescent filament.—*Abstracted from the Bulletin of the Bureau of Standards (Washington), December.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Luminous Arc Lamp for Multiple Operation.

A luminous metallic arc lamp for low-voltage, direct-current, multiple circuits, 100 to 125 volts, was brought out in 1906 by the General Electric Company. This multiple lamp was a modification of the series lamp, requiring in addition to the necessary regulating magnets and steadying resistance, shunt magnets for striking the arc and a cutout for protecting the shunts.

It was thought advisable to develop an improved type, as shown in Fig. 1, which resembles quite closely in outline and general dimensions the standard type of General Electric enclosed lamp. The lamp is of pleasing appearance and of suitable size for installation on multiple circuits.

FIG. 1.—GENERAL VIEW OF THE IMPROVED FORM OF LUMINOUS ARC LAMP FOR MULTIPLE OPERATION.

The casing is of solid copper with a black oxidized finish, and furnishes a strong and durable housing for the lamp mechanism and a support for the outer globe and its supporting ring.

The standard No. 5 outer globe is used, but the lower surface is ground to eliminate shadows directly underneath the lamp, and to obscure from view the small metal pan placed in the bottom of the globe to catch the iron oxide.

Fig. 2 is an interior view of the lamp, showing the mechanical construction. The main frame consists of a one-and-one-half-inch iron pipe connecting the top and base castings, forming a rigid construction, and at the same time providing a suitable centre draft or chimney for disposing of the arc fumes. At the top this chimney is protected from rain and storms.

The upper or positive electrode consists of a T-shaped drop-forging of copper. With a large volume of copper and a large radiating surface it is possible to keep the electrode at a low temperature, and this condition, together with the peculiar characteristics of the luminous arc, results in a slow wearing away of the copper. To decrease this oxidization further and increase the life of the copper electrode, an iron tube is fitted tightly around the latter, leaving the copper bare for the arc contact. With a four-ampere lamp this upper electrode will require renewing after about 1,800 hours of operation; or, with an average burning of five hours per day, this upper electrode should last a year.

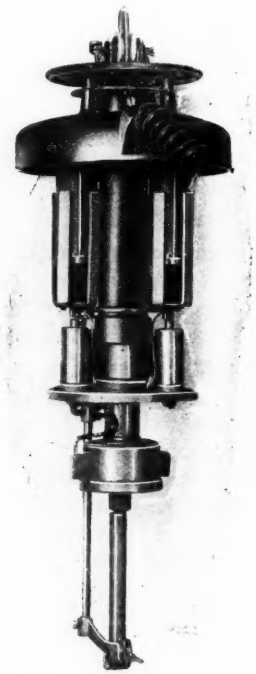


FIG. 2.—THE MECHANISM OF THE LUMINOUS ARC LAMP FOR MULTIPLE OPERATION.

The lower electrode, which is responsible for the characteristic flaming arc of this lamp, is an iron tube, eleven-sixteenths of an inch in diameter and five and three-fourths inches in length, filled with the prepared composition. One electrode only is used at each trimming, with a life of about 150 hours.

The non-consuming copper electrode and the electrode box are attached to and carried by a non-corroding Benedict-nickel tube. This tube passes inside of the draft chimney and comes in contact with, and is carried by, the lamp-clutch. This clutch consists of five phosphor-bronze balls, wedging between an inclined plane of the clutch-ring and the tube to be lifted.

There are two single magnets with the two E armatures mechanically connected. Their actions are positive, and at the same time remarkably sensitive, responding quickly to any variations of the line or arc, and thus maintaining a close regulation of the current.

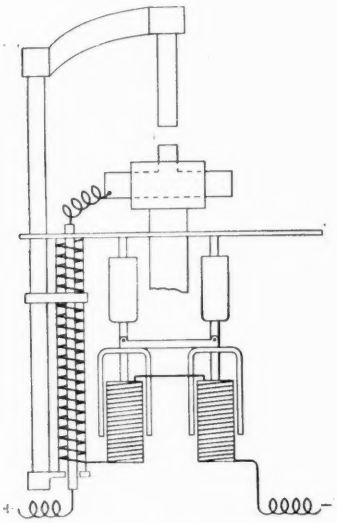


FIG. 3.—DIAGRAM OF THE WORKING PARTS OF THE MULTIPLE ARC LAMP.

The magnet windings, as well as the resistance, are of the well-known edgewise type. All leads are insulated with glass beads.

Two one-inch dash-pots are used, which provide the necessary retarding effect, with a large clearance between the shell and the graphite plunger.

Fig. 3 shows the simplicity of the connections. Only the electrodes, lifting magnets and steadying resistance are in circuit, and these are connected directly in series. The lamp is equipped with leading-in cables on account of the fumes which might accumulate and ground metal

binding-posts. The magnetite lamp will be furnished without switches, as these are seldom called for.

The characteristic distribution of the metallic flaming arc, with its maximum intensity near the horizontal, is well known. This natural distribution can be changed to meet other street-lighting requirements by the use of correctly designed concentric wave reflectors.

Four amperes and seventy-three volts at the arc will be the standard adjustment for 110-volt circuits. Special windings for 4.5 or five amperes can be furnished, if required, but the electrodes give shorter life when operated at the higher current.

In general the lamp needs little attention. At each trimming it is necessary to clean the centre or draft tube, and also the box containing the upper electrode. A suitable brush is provided for the purpose.

A small metal ash-pan is furnished, which is to be placed in the bottom of the globe. This catches the reddish-brown particles given off by the burning away of the lower electrode, and can be easily emptied at each trimming. Some of the fumes go through the draft tube and out into the air, thus rendering the use of the lamp objectionable for certain indoor installations where such fumes would be deleterious. The lamp is specially recommended for the lighting of foundries, machine shops, train sheds, freight houses, freight yards, drill halls, and riding academies, or in general for the lighting of large areas where the fumes are not noticeable.

It is imperative that this lamp be so connected that the composition electrode is negative. To facilitate the correct connections being made to the circuit, the lamp top is plainly marked "positive" and "negative" above the respective leading-in cables. Should the lamp be operated with the copper electrode negative, it will burn with a low efficiency copper arc, which will continually rupture itself.

Orangeburg Fibre Conduit.

Since the manufacture of Orangeburg fibre conduit began, in 1898, the market for this product has grown steadily and rapidly. The character of this material, then a complete novelty, and the success which has been attained by the conduit in practical employment render it one of the most interesting departures which, in recent years, has been connected with underground construction.

The material of which Orangeburg fibre conduit is made is wet wood pulp, which is itself, of course, a mass of coherent and interlaced cellulose fibres. This material was chosen by the incorporators of the Fibre Conduit Company, after years of experiment and study of the needs of the service, as that most nearly ideal. Since its inception Orangeburg fibre conduit has been endorsed for practical use by telephone, electric light and power companies and by telephone and electric light engineers throughout the United States, Canada and England. The conduit is now in use in every state in the Union and in every prosperous European country.

The principle embodied in the manufacture of the conduit is itself of great simplicity. In making the conduit wet wood pulp, in an excessively thin film, is wrapped under pressure upon a forming mandrel, the individual fibres becoming unseparably united into a solid and practically homogeneous wall. Taken off the mandrel the wet pulp structure is subjected to an air-drying process, after which it is placed in a vat of insulating and preservative liquid which thoroughly permeates the entire structure. After treatment the walls of the conduit, upon cutting, present a strong resemblance to hard rubber.

Orangeburg fibre conduit is manufactured in socket-joint, sleeve-joint and screw-thread types. The last two kinds are employed when it is inadvisable or unnecessary to use concrete. In the socket-joint type, which is the most frequently used, the socket or slip connections are cut on the ends of each length of conduit and are automatically turned. The socket connections are three-eighths of an inch long, slightly tapering and uniform in size. During the process of cutting the inside of the joint is reamed so that there can be no offset at the joints when laid. Owing to the automatic formation of the joints the connections made in laying the conduits are perfect in fit and alignment. Bends are manufactured of all necessary sizes and radii to meet turns and curves.

The great advantages as a tube offered by the conduit are most obvious in connection with the junction of the conduit units. The male and female joints are accurately cut, so that it is merely necessary to push one within the other to secure permanent alignment and, without the use of a coupling compound, to form a water-tight and gas-proof connection. No mandrel is needed to secure alignment, nor is it necessary to wrap each joint with burlap.

Because this conduit is manufactured from thin wood films the interior of the duct is finished as a perfectly smooth wall, without burrs or blisters of any description, giving a smooth surface for the drawing-in of cables.

Orangeburg fibre conduit prevents injury of any description to the cable sheath. But, besides the extreme value it possesses from a mechanical standpoint, there are advantages in its use of economical importance. These advantages follow logically from the extreme lightness of the ducts, a direct consequence of the material of which the conduit consists, and it shows no deterioration from the action of gas; is waterproof and not attacked by acids or alkalies; is unaffected by moist earth and lasts indefinitely under ground. It is an excellent non-conductor and practically does away with the trouble due to stray electrical currents.

National Batteries at the Chicago Automobile Show.

At the recent automobile show held in Chicago the National Battery Company, Buffalo, N. Y., made an exhibit of a complete line of "National" sparker, vehicle and truck batteries. The general appearance of the "National" sparker for 1908 is the same as the 1907 battery, with an improvement in the process of assembling and sealing. Six-volt, sixty-ampere-hour and six-volt, forty-ampere-hour batteries were shown operating spark coils and lamps. The vehicle batteries showed the new "National" method of sealing without the use of sealing compound. The vehicle and truck batteries for 1908 are equipped with non-corrosive terminals. There were also exhibited a panel board and posts and accessories. The exhibit was in charge of Bertram Smith, Chicago manager, assisted by the district salesmen and staff of engineers.

Dale Company Licensed Under Benjamin Cluster Patents.

The Benjamin Electric Manufacturing Company, Chicago, Ill., announces that the Dale Company, New York, has purchased a license to market its line of wireless clusters which the United States Circuit Court of Appeals for the Second Circuit recently held to infringe the Benjamin patent. The Dale Company has made settlement for all past infringement by the Dale Company and by those who have purchased, used or sold these clusters.

Spanish Telephone Extensions.

Consul-General B. H. Ridgley, of Barcelona, advises that a royal order was published in the Spanish *Official Gazette* on November 12, inviting tenders from native firms for the installation of a telephone system connecting with the French wires at the frontier towns of Irun and Portbou, the details being as follows:

The line will start from Madrid and at Zaragoza branch off in two directions, one passing through Pamplona, Tolosa and San Sebastian to Irun, and the other following the line through Lerida to Barcelona and Tarragona, and thence on through Gerona to Portbou on the French frontier, thus establishing communication between Barcelona and France. Stations will be placed at all the towns named above. The work will have to be commenced before July, 1908, and terminated within the year. The contractors will be required to line up a number of other towns lying near the main route.

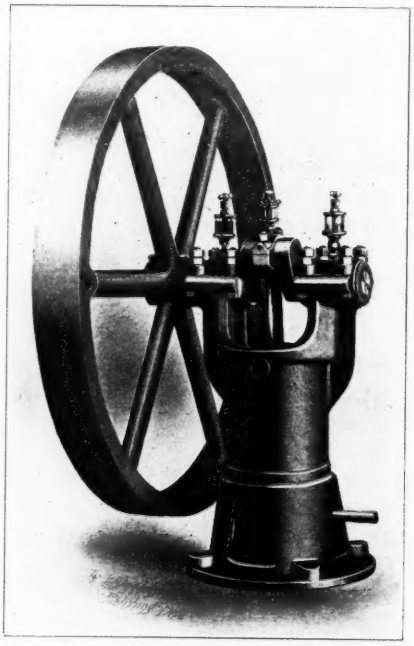
Tenders are also solicited for the construction and working of telephone systems connecting Madrid with Coruna and Ferrol, with Pontevedra by way of Orense and Vigo on to Gijon, Santander and several other smaller towns. This will be known as the Northwestern System. Another, the Southeastern System, will connect Madrid with Cartagena, Albacete, Alicante and Murcia, Almeria, Lorca, Linares, Jaen, Granada, Baza and Motril. Another system, to be known as the Southern Telephone System, will link up Madrid with Cadiz, passing through Ciudad Real, Almaden, Cordova, Seville and Jerez; with Malaga, by way of Bobadilla and with Huelva, Caceres, Badajoz and Zafra.

Inasmuch as only native firms are invited to compete for these contracts, their interest for American exporters lies in the fact that large orders will naturally be given by the contractors for wire, posts, insulators and other material as soon as the contracts are finally signed, which it is expected will be in January next. American firms may or may not think it worth while to send representatives here to solicit orders. At present, the telephone companies of Spain buy their wires principally in Germany and their apparatus in Paris and Stockholm. It would naturally be difficult to persuade the companies to change the system now in use. On the other hand, some of our long-distance apparatus might be profitably introduced here.

A New Westinghouse Air-Compressor.

The Westinghouse Air-Brake Company has been for some years supplying various industries using compressed air with its standard steam and motor driven air-compressors. In a large number of industries, however, there is a demand for a compressor of small capacity. The company has therefore developed a small belt-driven compressor, which has now been thoroughly tried out, and which it is prepared to manufacture in large quantities.

The new compressor, which is a three-inch by four-inch belt-driven unit, is characterized by the same attractiveness of design and construction as the larger apparatus now standard in railway and traction



WESTINGHOUSE AIR-COMPRESSOR.

practice and equally successful in commercial work. The weight of the complete unit is 218 pounds and its base is twelve inches in diameter. Its compact build enables it to be located in limited space wherever power from shafting or small motor drive is available. It is particularly adapted to gas-engine starting, automobile-garage use, charging storage tanks for small pneumatic tools, general machinery cleaning and in a great variety of cases where compressed air at high or low pressures, but in small quantities, is required.

The compressor is of the vertical single-cylinder, single-acting, water-jacketed type, operated by power delivered to a thirty-inch flywheel attached to a crank shaft, the rotation of which drives the piston in the cylinder by means of a connecting rod. The diameter of the air-cylinder is three inches, the stroke of the piston is four inches and the rated capacity of the pump is four cubic feet of free air at 250 revolutions per minute. It will operate satisfactorily against any air pressure up to 250 pounds. At 250 revolutions per minute, its speed of maximum efficiency, and against 200 pounds air pressure, approximately one brake horsepower is required.

Since the act of compressing air always raises its temperature, the cylinder is surrounded by a water jacket, through which a constant circulation of water is maintained, thus lowering the temperature of the discharged air and increasing the efficiency of the compressor and at the same time greatly reducing the effects of overheating, due to prolonged operation.

Metropolitan Electric Repair Protective Association.

A number of gentlemen, representing the leading electrical repair companies of New York city, met on Thursday night, December 12, in the rooms of the Modern Science Club, 125 South Elliott place, Brooklyn, N. Y., for the purpose of organizing a trade association, the necessity of which has long been felt. James F. Hughes, of the Charles A. Borne Company, New York, was elected temporary chairman and Leopold F. Luedecke, of the Thompson-Bonney Company, Brooklyn, was elected temporary secretary. Mr. Hughes stated the purpose of the new association, emphasizing the essential reasons why such an association should be called into existence. He touched upon the abuses and impositions the repair man has become more and more exposed to by irresponsible parties, and said that the time was ripe for them to organize in self-defense. This sentiment was enthusiastically received, and a general debate ensued in which the most salient points of the repair business were discussed.

It was decided to name the new organization "The Metropolitan Electric Repair Protective Association." The chairman appointed a committee to prepare a constitution and by-laws, consisting of John P. Bonney, chairman; Eugene E. Higgins, of the Graham Brothers Company, New York, and Leopold F. Luedecke.

Mr. Hughes read letters from the electrical repair companies not represented at the meeting who promised their hearty cooperation.

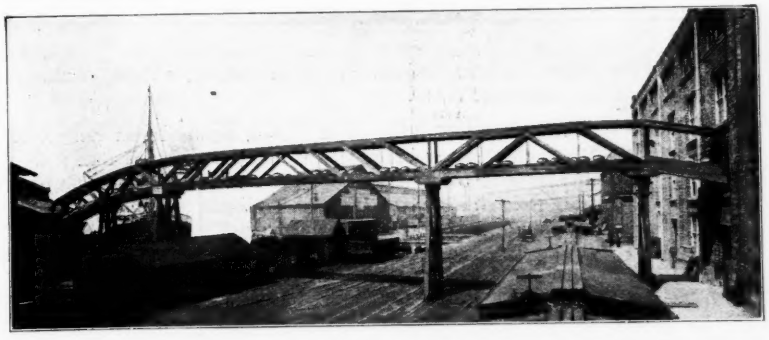
The meeting was then adjourned, to meet again January 16, 1908.

A Jeffrey Overhead Carrier at Seattle, Wash.

All steamboat cargo discharged or awaiting shipment at the Virginia Street dock in Seattle, Wash., is stored in a warehouse of the company, located on the opposite side of Railway avenue, distant about 250 feet from the dock.

To transfer the large volume of miscellaneous freight handled daily between the dock and warehouse economically and at the necessary speed without obstructing traffic in the street, the company has recently installed an overhead carrier which performs the work at a cost which is hardly appreciable and which is capable of handling the freight more rapidly than it is possible to load or dispose of it at the terminal points.

As the equipment is very simple and can be modified to suit practically any industrial condition which involves the movement of packages, or miscellaneous articles, in large numbers between fixed points, a brief description will be of general interest.



RAILWAY AVENUE, SEATTLE, WASH., WAREHOUSE AND CARRIER.

As shown by the accompanying illustrations, the dock and warehouse are connected by a light elevated structure which supports a continuously-moving carrier of the endless-chain type, with terminals on the dock level at one end and on the second floor of the warehouse at the other.

CARRIER AT DOCK END, SEATTLE, WASH.

The carrier consists of a series of wooden flights, nine inches wide by four inches thick and thirty inches long, made of Pugent Sound fir. These are secured every twelve inches to two strands of No. 180 Jeffrey steel thimble roller chain, forming a practically continuous apron, on which the freight is carried. Wedge-shaped blocks attached to every third flight serve to push or retard such freight as might otherwise roll down the incline at the dock end.

The machinery is driven at the upper, or warehouse, end by a ten horse-power electric motor and, being reversible, it carries the freight to equal advantage in either direction. It is designed to handle packages not exceeding three feet wide and four feet high, which normally consist of salmon in cases, sacks of salt and sugar, barrels of cement and miscellaneous articles weighing as much as 1,000 pounds each. It travels at a speed of seventy feet per minute and consumes about six horse-power when delivering 1,000 packages, weighing one hundred pounds each, per hour. This rate of delivery is based on the speed at which the packages can be loaded and cared for at the terminal points, and is much below the actual capacity of the machine.

The plant was designed and installed by the Pacific Engineering Company, of Seattle, Wash., the conveying machinery being furnished by the Jeffrey Manufacturing Company, of Columbus, Ohio.

A conveyer of this type will often pay for itself in a few months, and, if properly built and operated, it will last for many years, practically without repairs or renewals.

The Jeffrey Manufacturing Company has installed several machines of this general character for delivering freight to, and receiving it from, ships direct, the outer end being made adjustable to the rise and fall of tide and freeboard of vessels.

Illuminating Engineering Society.

The next meeting of the New York section of the Illuminating Engineering Society will be held in the Engineering Societies Building at 8.15 P. M., Thursday, January 9. A paper by Dr. H. H. Seabrook on "Light and the Eye" will be presented and discussed.

A meeting of the Boston section of the Illuminating Engineering Society was held on December 18. The meeting was called to order by Chairman Campbell at 8.20 P. M. The chairman, after calling attention to the fact that the next session will be the annual meeting of the society, introduced Professor Puffer, who presented an interesting paper on "The Variables of Illuminating Engineering." Considerable discussion followed, participated in by Professor Puffer, Professor Clifford, Dr. Bell, Messrs. Campbell, Codman, Hatch, Ware, Curry and others.

Current Electrical News

DOMESTIC AND EXPORT.

TELEGRAPH LINE FOR TIBET—The construction of a telegraph line into Lhassa, the capital of Tibet and the residence of the Dalai Lama, the supreme head of the Lamaist hierarchy, has been sanctioned. This innovation was recommended by a Chinese resident at Lhassa, who, since the advent of the British expedition of 1904, has been working for the enlightenment of the Tibetans.

HUDSON RIVER ELECTRIC POWER COMPANY GRANTED PERMISSION TO ISSUE $3,000,000 BONDS—The Hudson River Electric Power Company has been granted permission by the Up-State Public Service Commission to issue $3,000,000 in bonds to construct a storage and electrical power dam on the Sacandaga river for the purpose of supplying electricity in Saratoga, Ballston, Mechanicsville, Troy, Albany, Watervliet, Schenectady and Amsterdam, N. Y. The company asked for permission to issue bonds amounting to $2,232,000. The order to be issued will contain provisions requiring the company to report under oath the sale or sales of the bonds authorized, the terms and conditions of such sale and the amount realized therefrom, and to make a verified report at least once in every six months showing in detail the use and application by it of the moneys so realized until such moneys shall have been fully expended. As this is the first case arising before the commission which involves the issuance of additional stock and bonds by the applying company, the commission has endeavored to indicate what consideration or tests will be applied in the determination of cases of this character. The opinion by Commissioner Decker sets forth definitely that an application to issue additional capital involves the following principal considerations: The purposes to which the proceeds arising from the sale of the securities are to be applied; the amounts reasonably necessary for the consummation of such purposes, and the character of the securities proposed to be issued. The final consideration mentioned in the opinion is as to whether there is a reasonable prospect of fair return upon the investment proposed, to the end that securities having apparent worth but actually little or no value may not be issued with the sanction of the commission.

TELEPHONE AND TELEGRAPH.

AVOCA, N. Y.—The Overland Telephone Company is erecting a direct wire to Bath.

SOUTH WENTWORTH, N. H.—The White Mountain Telephone Company has begun work on a new line to extend from West Rumney into Dorchester.

BALTIMORE, MD.—The Chesapeake & Potomac and the Maryland Telephone companies have made new contracts with the city at lower rates than those now in effect.

SYCAMORE, ILL.—The De Kalb County Board of Supervisors has given the Exchange Telephone Company a franchise to do business in this county. Work will begin at once.

COLUSA, CAL.—The Colusa County Telephone Company is making progress in building its system throughout Colusa county. All the poles have been set in Colusa, Arbuckle, Williams, Maxwell, Grimes and Princeton, and the crew is now stringing lines.

TREZEVANT, TENN.—The Trezevant Telephone Company has been organized for the purpose of establishing an independent system in Trezevant. O. C. Sloan was elected president, and Nevins Arnold secretary. The company will connect with the Dixie and other independent lines in the adjacent territory.

SPOKANE, WASH.—The city of Wallace, Ida., has granted Walter C. Clark and Daniel G. Price a franchise to maintain a telephone system. The system is to be in operation in six months from the date of the first publication of the franchise. The line will connect with the lines already built by Messrs. Clark & Price and later with the Interstate company's lines. Wallace has a population of 15,000.

SPOKANE, WASH.—A. E. Harris, deputy forest ranger, Palouse National Forest, southeast of Spokane, announces that a telephone line is to be built next year from Palouse, Wash., along the forest trail from Woodfell to the Chadi ranger station, seventeen miles. Ten miles of the trail is completed. The object of the trail is to aid the fire patrol, and to enable stockmen to get supplies into the range with greater ease.

HOUSTON, TEX.—Fred Reed and John Slusher, the organizers of the Home Telephone Company in Houston (automatic) as well as the organizers of an automatic company for Galveston, have closed contracts for the purchase of supplies and the needed apparatus. They expect that they will be ready to begin active work within forty or sixty days. It is the purpose of the company to expend about $600,000 in the installation of the plant.

HARRISBURG, PA.—The Bell Telephone Company of Philadelphia has filed notice of a change of name to the Bell Company of Pennsylvania, due to the recent absorption of the Pennsylvania Telephone Company and the Delaware & Atlantic Telephone Company, and an increase in its capital stock from $30,000,000 to $60,000,000. The new company will operate in Pennsylvania east of the Alleghany Mountains, and in Delaware, Virginia, New Jersey, Maryland and the District of Columbia, and will have its headquarters in Philadelphia.

NEW YORK, N. Y.—Charles L. Lapham has filed plans in the Bronx for a wireless telegraph station, to be the permanent station for New York city in a chain of wireless telegraph posts across the country. The building is to be erected at 170th street, east of Jerome avenue on a lot thirty feet by thirty feet, and is to be 200 feet high. Mr. Lapham, who is an official of the Pacific Wireless Telegraph Company, said that the local station will be on a chain from Chicago to Boston, with branches to the principal cities to the South. The company's line, he added, is now in operation between Chicago and Milwaukee.

NEW HAVEN, CT.—No plans have yet been made for the election of a president of the Southern New England Telephone Company to fill the vacancy caused by the death of Morris F. Tyler. James T. Moran, a director and counsel of the telephone company, states that the company will be operated for the present under the direction of Vice-President James English and the committee of the board of directors appointed by President Tyler some months before his death, and consisting of General Thomas Sherwin, of Boston; Judge A. Heaton Robertson, John W. Alling, Max Adler and James T. Moran. The annual meeting of the company will be held on Tuesday, January 28, and it is considered doubtful if any definite action will be taken in regard to President Tyler's successor before that time.

DATES AHEAD.

American Association for the Advancement of Science. Annual meeting, Chicago, Ill., December 30 to January 4.

South Dakota Independent Telephone Association. Mitchell, S. D., January 8-9, 1908.

Chicago Electrical Show. Coliseum, Chicago, January 13-25, 1908.

International Independent Telephone Association. Annual meeting, Chicago, Ill., January 21, 22 and 23, 1908.

Nebraska Independent Telephone Association. Next meeting, Omaha, Neb., January, 1908.

Wisconsin Electrical Contractors' Association. Next meeting, Milwaukee, Wis., January 15, 1908.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January 15-16, 1908.

Ohio Independent Telephone Association. Next meeting, Columbus, Ohio, March 19, 1908.

PERSONAL MENTION.

MR. C. M. HOBBS has resigned as general manager of the Nevada-California Power Company, Tonopah, Nev., and will spend some time abroad. Delos A. Chappell, of Denver, Col., who was recently elected president of the company, will also assume the duties of manager.

MR. LLOYD LYONS, formerly assistant manager and assistant treasurer of the San Juan Light and Power Company, of San Juan, Puerto Rico, has been made secretary of the Mobile (Ala.) Light and Railroad Company, and is now in charge. Mr. J. E. Z. Watson, the former secretary, who held the position for more than a year, has returned to St. Louis, where he will engage in business.

MR. THOMAS F. BECHTEL, general auditor for the Grand Rapids-Muskegon Power Company since the amalgamation of that enterprise with the Grand Rapids Edison Company last summer, has resigned his position, to take immediate effect. Mr. Bechtel has made no definite business plans for the future, and will not do so until after his return from a trip to Florida and Cuba in search of rest and recreation. Mr. Bechtel has been connected with the electric light and power business in Grand Rapids since the organization of the Grand Rapids Edison Company, about twenty years ago. Its extensive growth and successful development have been largely due to his energy and personal efforts as secretary and treasurer.

MR. J. W. AGER, electrical aide in the Bureau of Yards and Docks, United States Navy Department, has resigned to enter the employ of Muralt & Company, New York city, as manager of the southern office, in Birmingham, Ala. Mr. Ager is a graduate of Columbia University, with the degree of M.E., and of Massachusetts Institute of Technology, with the degree of E.E. During 1905 and part of 1906 he was an engineer with the Western Electric Company, in New York city, and since that time has been in the service of the United States Navy Department. His last work in this connection was with the engineering and construction being carried out in the movement to consolidate the power plants in the various United States navy yards.

MR. H. W. CLAPP was tendered an informal luncheon at the Engineers' Club on Saturday, December 14, by some of his business friends in New York. Mr. Clapp has recently accepted a position in the electrical organization of the Southern Pacific Company, and will shortly move to San Francisco. Among those present were: W. J. Clark, manager traction department; T. Beran, manager New York office; J. G. Barry, manager railway department; W. B. Potter, engineer railway department, General Electric Company; A. R. Whaley, general superintendent electric zone; C. L. Bardo, superintendent electric zone, New York Central & Hudson River Railroad Company; J. S. Doyle, superintendent car equipment, Interborough Rapid Transit Company; H. N. Latey and F. R. Slater, of Latey & Slater Company; W. H. Sawyer, engineer, Ford, Bacon & Davis; J. R. C. Armstrong, electrical engineer; Alexander McIver, superintendent equipment; W. C. Campbell, assistant superintendent equipment, New York City Railway Company; F. V. Greene, Westinghouse Air-Brake Company; A. H. Sisson, St. Louis Car Company; J. G. Buehler, president and treasurer, Columbia Machine Works, New York city; C. S. Hawley, Consolidated Car Heating Company. During the five and one-half years he has spent in and about New York, Mr. Clapp has been engaged in some of the most important electric railway propositions as special representative of the railway engineering and construction departments of the General Electric Company. He is a son of F. Boardman Clapp, managing director of the Melbourne (Australia) Tramway and Omnibus Company. Before coming to America Mr. Clapp was for four years superintendent of motive power of the Brisbane Tramway Company, Brisbane, Australia.

NEW INCORPORATIONS.

LANSING, MICH.—Pellston Light and Power Company, Pellston $35,000.

FARGO, N. D.—The Montpelier Telephone Company, Montpelier, N. D.; $5,000; incorporators, Frank S. Eddy, R. C. Carley, M. H. Johnson and others of Montpelier, N. D. The Western Telephone Company, Sawyer, N. D.; $50,000; incorporators, William Hodges, O. J. Mortenson, both of Sawyer, N. D., and N. T. Weum, of Minneapolis, Minn. Hegton Telephone Company, Arvilla, N. D.; incorporators, W. G. Williams, M. McCabe, Owen Williams, all of Arvilla, N. D.

ELECTRIC LIGHTING.

ERIE, PA.—The electric lighting contract has been awarded to the Erie County Electric Company.

SAYBROOK, ILL.—William Schuler has become the owner of the Mansfield electric light plant.

GRASS VALLEY, CAL.—The Sultana Mine Company is considering the installation of an electric plant, to cost $20,000.

HAGERSTOWN, IND.—A site has been purchased for the proposed town electric light plant, and work will soon begin.

ROANOKE, IND.—Steps have been taken by the town board of Roanoke to construct and equip an electric light plant.

MOLINE, ILL.—A new 5,000-horse-power turbine unit has been installed at the Moline plant of the People's Power Company.

EASTCHESTER, N. Y.—The town supervisor has proposed the establishment of a municipal light plant, and the matter is under consideration.

MUSKEGON, MICH.—The Muskegon Heights council has entered into a one-year lighting contract with the Muskegon Traction and Lighting Company.

KEWAUNEE, WIS.—A special election will be held on January 18 to decide whether the city shall install an electric light plant or give the contract to a private company.

FRESNO, CAL.—The Mount Whitney Power Company has made application to the board of supervisors for a franchise to extend its electric power line into Whitney county.

McCOOK, NEB.—The McCook Electric Light Company has added to its present plant two thirty-five-kilowatt, direct-current generators, belted to a 100-horse-power Weber producer gas engine.

GOUVERNEUR, N. Y.—The Hannawa Power Company has purchased what is known as the Gardner property on the West Side, and will construct its transforming station upon that site.

HUNTINGTON, W. VA.—The city council has awarded the street-lighting contract for the next ten years to Harry H. Hughes, whose bid was $47 per lamp. The contract goes into effect January 1, 1909.

LIGONIER, IND.—At an election held for the purpose it was voted to install and operate a municipal electric light plant. The estimated cost of such a plant has been placed at from $20,000 to $25,000.

LECOMPTE, LA.—The board of aldermen has decided to adopt the electric light plant specifications submitted by C. Scott Yeager, of Alexandria. Baldwin Wood, of New Orleans, will supervise the construction of the plant.

ALBANY, N. Y.—The Public Service Commission of the Second District has granted the petition of the Orange County Lighting Company for authority to issue $40,000 bonds under a mortgage for $300,000, dated March 1, 1905.

TULSA, OKLA.—The Tulsa corporation, successor to the People's Gas and Electric Company, will spend between $75,000 and $100,000 within the next three months on its electric plant. Contracts have been signed for the equipment.

SODUS, N. Y.—The Sodus Gas and Electric Light Company has filed a petition with the Public Utilities Commission for authority to issue $75,000 additional capital stock, and thereby to increase its capital stock from the present amount of $15,000 to $90,000.

SOUTH SAN FRANCISCO, CAL.—W. J. Martin, of the South San Francisco Land and Improvement Company, has been awarded a franchise and the right to erect poles and wires for the furnishing of electricity for power and light in this township by the board of supervisors.

NEW YORK, N. Y.—At a special meeting of the stockholders of the Nassau Light and Power Company it was voted to mortgage the property and franchise of the company to secure an issue of $1,000,-

000 in five-per-cent bonds, dated October 1, 1907, and payable October 1, 1927. The plant is located at Roslyn, N. Y.

TRINIDAD, COL.—Aguilar, one of the most prosperous camps in Las Animas county, wiill soon be equipped with an electric light and power plant, the city council having granted a twenty-year franchise to Hawkins & Barnett, of this city, who will immediately commence the construction of a $25,000 plant.

WASHBURN, WIS.—The city council has concluded the purchase of the outside equipment, good will, and business of the Washburn Electric Light and Power Company. The power plant was also leased. The lighting plant will be managed by a commission composed of five members appointed by the mayor.

OTTAWA, ONTARIO—The Ottawa city council has completed an arrangement with the Ottawa Electric Company for the purchase of the street-lighting plant, which will be added to the general electric plant already owned by the municipality. The price agreed upon is $29,000. The city will take possession on December 28.

HAMILTON, OHIO—At a stockholders' meeting of the Columbia Gas and Electric Company, held recently, James C. Ernst, of Covington, was elected a vice-president of the company. The stockholders decided not to issue $1,000,000 preferred stock, as had been planned, and the capital will consist of $50,000,000 common stock only.

BOSTON, MASS.—The Charlestown Gas and Electric Company has petitioned the board of gas and electric light commissioners for authority to issue additional capital stock to the amount of $100,000, and for permission to use the proceeds of this issue for the payment of its floating debt and the cost of permanent additions to the plant.

ALBANY, N. Y.—The hearing on the petitions for authority to issue $100,000 stock and a mortgage of $500,000, with bonds of $300,000 to be issued under such mortgage, has been postponed until January 20 in the case of the Niagara Falls Lighting Company. The petition for the extension included permission to build a large plant at Niagara Falls.

RAPID CITY, S. D.—The Dakota Power Company, newly organized, has taken over all the neighboring water, flume and ditch rights in this vicinity and proposes to furnish Rapid City and adjacent territory with light and heat. Its plant will have a capacity of 1,600 horse-power and will be in operation some time during the coming year.

ROCK ISLAND, ILL.—At a meeting of the East Moline city council, Harry D. Swartz, manager of the Central Union Telephone Company, and Charles E. Knorr, who represent the Electric and Gas Heating and Lighting Company, presented an ordinance for a twenty-year franchise to furnish street lights for the city and also to light the city hall.

McDONALD, PA.—August Valentour, W. H. Young, B. Frankell, G. W. Smith and D. L. Williams have applied for a charter for the organization of an electric heat and power company to be formed in McDonald. The organization will be known as the McDonald Electric Light, Heat and Power Company and will supply electricity to McDonald and surrounding towns.

BOSTON, MASS.—The gas and electric light commissioners have granted the Stockbridge Lighting Company permission to issue 250 shares of new capital stock of the par value of $100 each. The proceeds of 222 shares are to be devoted to the payment of the cost of the company's distributing plant, and the proceeds of twenty-eight shares to be used for working capital.

EAGLE LAKE, TEX.—At a reorganization of the water, electric light and gin plants Dr. F. O. Norris was elected president and M. E. Guyun, of this city, and G. O. Herder, of Weimar, were elected directors. J. C. Semprez and Hoynie Matthews were reelected directors. The first-named gentlemen took the places of B. L. Vineyard, A. M. Waugh and L. T. Hahn, resigned.

SCRANTON, PA.—To supply electric light for Olyphant and Archbald, and possibly Jessup, a new company is being formed by the following residents of that portion of the county and will secure a charter from the department at Harrisburg: John J. Sweeney, Henry V. Lawler, B. J. McGuire, W. G. Robertson, John Smoulter, B. J. Cummings, Andrew Smolka, C. P. Ford and Frank Hemmelright. Attorney James J. O'Malley represents the company.

MENOMONIE, WIS.—The new water-power plant of the Chippewa Valley Electric Railroad Company in this city is now developing power. Regular service will be established to Eau Claire shortly. The first development is 3,000 horse-power which will be increased. The ultimate plan contemplates bringing the power from Cedar Falls and Downsville to this city. It is estimated that about 1,000 horse-power can be developed at each of these points on the Red Cedar river.

GREENCASTLE, IND.—Paul H. White, of Indianapolis, is an applicant for a franchise empowering his company to bring a high-tension wire through this city and to furnish electricity for light and power. The company with which Mr. White is connected is a new one that contemplates the construction of a large power plant in Vigo county for the generation of electricity to be transmitted to Indianapolis. Frank M. Fauvre, of Indianapolis, is one of the leading men in the enterprise.

ALBANY, N. Y.—On the application of the Nassau Light and Power Company to the Public Service Commission of the Second District for an authorization of the acquirement of $35,000 capital stock of the Oyster Bay Electric Light and Power Company an order has been issued by the commission granting the petition. The stock of the Oyster Bay company was actually purchased by the Nassau Light and Power Company in 1905, without applying as required by law to the commission of gas and electricity. In its petition to the Public Service Commission the company claimed that it was ignorant at the time that such consent should have been secured and had acted in good faith in the matter.

FARIBAULT, MINN.—The Scott mill and water power, located several miles north of this city on the Cannon river, which has been purchased in connection with the Polar Star electric light and power plant in this city, by the Northern Heat and Electric Company, of St. Paul, will be greatly improved during the coming season. Four hundred horse-power can be developed. A new concrete dam will be put in and many other improvements made at the mills. Several engines will also be installed to be used in case of low water. The power will be conveyed to this city, to be used in the light and power plant. There is also a possibility that power may be furnished for the proposed electric line to be built through here by Twin City capitalists.

PORTLAND, ORE.—A report and estimate of expenses of the city lighting department, submitted to the mayor by Thomas G. Greene, D. A. Pattulo and M. A. Fleischner, of the executive board, favors a municipal plant for Portland. About $100,000 yearly is required for electric lights furnished by the Portland Railway, Light and Power Company. As the municipality grows, the report states, the expense of this department will increase. In view of this fact the committee suggests that it would be well to investigate conditions with the object of establishing a lighting plant, from power furnished by Bull Run river. The report of the committee states that Portland is a poorly lighted city at present, and recommends at least seventy-five additional arc lamps in various sections for next year. The contract with the Portland Railway, Light and Power Company expires December 31, 1908.

WATERTOWN, N. Y.—By a decision of the Public Service Commission anent the application of the Watertown Light and Power Company for leave to issue stocks and bonds to the amount of $280,000 for improvements made on their plant and property, the entire litigation which the city has been conducting against the company is practically closed, the decision being in effect a complete victory for the lighting company. The decision states in part that the commission will not investigate nor inquire into the correctness of the capitalization of the lighting company, as authorized by the former commission, or inquire into any alleged over-capitalization existing at that time, and holds that it results from the above that the evidence proposed to be given by the city of Watertown as to the value of the physical properties of the applicant will not be required; that no further inquiry will be made into the subject of the value of the properties of the Watertown Light and Power Company; that the case shall be considered as closed, and determination shall be made upon the record hereto made.

ELECTRICAL SECURITIES.

The market last week continued dull and irregular, and followed the drifting characteristics of the previous two weeks. Although the trading was dull and professional, some gains were registered, and the market as a whole has a slightly more hopeful appearance. It is understood that large banking interests are opposed to radical price movements one way or the other, and a very effective weapon has been used in the bankers' control of the money market. There has been some improvement in investment buying, and it is chiefly in the bond list that advances have been recorded. The end-of-the-year dividends, it is expected, will create an easier monetary condition, and this may result in considerable exchange of currency, and thus stimulate the market.

Dividends have been declared upon the following electrical securities: Cincinnati (Ohio) Street Railway Company; regular quarterly dividend of 1½ per cent, payable January 1. Bell Telephone Company of Philadelphia; regular quarterly dividend of 1½ per cent, payable January 15. Consolidated Traction Company, Pittsburg, Pa.; regular semi-annual dividend of 1 per cent on the common stock, payable December 31. Manchester (N. H.) Traction, Light and Power Company; regular quarterly dividend of 2 per cent, payable January 15. St. Joseph (Mo.) Railway, Light, Heat and Power Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable January 1. Tri-City Railway and Light Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable January 2. Little Rock Railway and Electric Company; regular semi-annual dividends of 3 per cent on the preferred and 2 per cent on the common stock, payable December 31. United Traction Company, of Pittsburg, Pa.; regular semi-annual dividend of 2½ per cent on the preferred stock, payable January 20. Regular guaranteed semi-annual dividend of $2 per share on the preferred stock of the West End Street Railway, Boston, Mass., payable January 1. Havana (Cuba) Electric Railway Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable January 15 to stock of record December 31. Sao Paulo (Brazil) Tramway, Light and Power Company; quarterly dividend of 2¼ per cent, being an increase of ¼ per cent from the last quarterly dividend of 2 per cent. Knoxville (Tenn.) Railway and Light Company; regular quarterly dividends of 1½ per cent on the preferred stock and 1 per cent on the common stock, payable December 31. Maryland Electric Railways Company, Baltimore, Md.; a semi-annual dividend of 1 per cent, payable January 2 to stockholders of record December 31. Six months ago 2 per cent was declared and a year ago an initial dividend of 1½ per cent was declared. Mexican Telegraph Company; regular quarterly dividend of 2½ per cent, payable January 15 to stock of record December 31. Central & South American Telegraph Company; regular quarterly dividend of 1½ per cent, payable January 8, to stock of record December 31. Massachusetts Lighting Companies; regular quarterly dividend of 1½ per cent, payable January 15 to stock of record January 1, 1908. Washington Water Power Company, of Spokane, Wash.; regular quarterly dividend of 1¾ per cent, payable January 2 to stock of record December 20.

ELECTRICAL SECURITIES FOR THE WEEK ENDED DECEMBER 21.

New York:	*Closing.*
Allis-Chalmers common	5¾
Allis-Chalmers preferred	16½
Brooklyn Rapid Transit	39⅞
Consolidated Gas	96½
General Electric	113½
Interborough-Metropolitan common	6⅜
Interborough-Metropolitan preferred	17¼
Kings County Electric	90
Mackay Companies (Postal Telegraph and Cables) common	53
Mackay Companies (Postal Telegraph and Cables) preferred	58⅞
Manhattan Elevated	116
Metropolitan Street Railway	—
New York & New Jersey Telephone	94
Western Union	55
Westinghouse Manufacturing Company	43¼

Boston:	*Closing.*
American Telephone and Telegraph	100¾
Edison Electric Illuminating	205
Massachusetts Electric	38
New England Telephone	102
Western Telephone and Telegraph preferred	—

Directors of the American Telephone and Telegraph Company have declared the regular quarterly dividend of 2 per cent, payable January 15 to stock of record December 31.

At the annual meeting of the Massachusetts Electric Companies, held December 18, the following-named trustees were reelected for three years: Gordon Abbott, Alexander Cochrane, Reginald Foster, Stillman F. Kelley, Walter Hunnewell. There were 206,377 votes cast, representing 123,985 preferred and 82,392 common shares. President Abbott stated that it was not the intention of the trustees to declare a scrip dividend representing back dividends until such a time as the Massachusetts Electric Companies was in a position to resume dividends at the regular rate of 4 per cent per annum. Assuming that the subsidiary companies are able next year to sell a substantial issue of bonds and provided that the companies do not greatly feel the effect of the business depression, he believed that preferred dividends would be resumed next fall. Since the close of the last fiscal year, ended September 30, the gross earnings of the subsidiary companies show an increase of about five per cent over last year.

Philadelphia:	*Closing.*
Electric Company of America	9¾
Electric Storage Battery common	28
Electric Storage Battery preferred	28
Philadelphia Electric	6½
Philadelphia Rapid Transit	17¼
United Gas Improvement	74½

Chicago:	*Closing.*
Chicago Telephone	109
Commonwealth-Edison	137½
Metropolitan Elevated preferred	46
National Carbon common	55
National Carbon preferred	100½

ELECTRIC RAILWAYS.

LOS ANGELES, CAL.—The Azusa-Glendora line of the Pacific Electric Railway Company was opened to Azusa December 4.

MONTREAL, QUEBEC—The Quebec Railway and Light Company will appeal to the Dominion Government for permission to increase its capital.

SOUTH BETHLEHEM, PA.—The South Bethlehem & Saucon Street Railway has placed in operation its line to Colesville, three and one-half miles.

TOLEDO, OHIO—The annual meeting of the Toledo Railways and Light Company will be held here January 16. The number of directors is to be increased from seven to nine.

PORTLAND, ME.—The preliminary survey of an electric railroad line from Limerick to East Waterboro has been completed and work will be commenced as early in the spring as possible.

RIVERSIDE, CAL.—Construction has been begun on the electric trolley line which is to connect Riverside and Colton. The contract for the grading has been let to Garnsey & Pitzer, of Los Angeles.

WOODLAND, CAL.—The Northern Electric Company has been granted a franchise to operate an electric railway the full length of Main street. The work within the city limits is to be completed before October 1, 1908.

BOSTON, MASS.—The railroad commissioners have approved the issue of $200,000 in bonds by the Worcester Consolidated Street Railway Company, to pay for floating indebtedness incurred in the construction and equipment of the road.

SALAMANCA, N. Y.—The Limestone division of the Western New York & Pennsylvania Traction Company has been completed and cars are running between Bradford, Pa., and Limestone, N. Y. Eventually the line will be continued through Limestone to Carrollton, where there will be a connection with the Clean-Salamanca division.

WALLA WALLA, WASH.—The Washington-Oregon Traction Company has submitted an ordinance requesting that a franchise be granted the company for right of way through certain portions of Walla Walla. The purpose of the company is to operate an electric line from the city to the Blue Mountains, a distance of some fifteen miles.

MIDDLETOWN, CT.—The Consolidated Railway Company is pushing the preliminary work for the electric road which is to

run from this city to Middlefield. A gang of workmen has been grading for a month, and it will continue to work as long as the weather permits. The line will be opened for business early next summer.

LITTLE ROCK, ARK.—The contracts for the construction of the grade for the new Little Rock & Pine Bluff Traction Company's interurban line between this city and Pine Bluff, have been let, and already work has been commenced on its construction. Ground has been broken at a point twenty-five miles from Little Rock, and the grading gang is working this way.

GARY, ILL.—work has been started on the line of the Gary & Interurban Railway Company, in the new town of Gary. The road will extend for three miles along the main street, connecting with the various railroads. Following is the board of directors: Frank N. Gavet, Whiting; M. N. Castleman, Gary; C. B. Manbeck, Whiting; W. E. Schrage, Whiting, and J. A. Gavet, Hammond.

BOSTON, MASS.—The railroad commissioners have received a petition signed by William S. Loomis and others, being a majority of the directors of the Holyoke Street Railway Company, asking for approval by the board of the issue of $120,000 in new capital stock in order to enable the street railway company to liquidate its bonded indebtedness assumed by the purchase of the Amherst & Sunderland Street Railway Company. No date has yet been fixed for the hearing.

PERU, IND.—The project to build an interurban line from Peru to South Bend, by way of Rochester, Argos and Plymouth, to work in connection with the Indianapolis and Peru branch of the Union Traction line between here and Indianapolis, is being revived. The company organized two years ago, composed of Benjamin E. Wallace, James O. Cole, Jerome Herff and Harry Masters, of this city, has incorporated and Indianapolis capitalists have become interested in the project.

BOULDER, COL.—The new generators for the electric cars which are to be run from Denver to Boulder by the Interurban road have been installed at Lafayette by the Northern Colorado Power Company, and construction on the new grade for the Colorado & Southern between Louisville and Denver is being rushed. When this grade is completed the Colorado & Southern will use it for its steam cars and will use the present grade for its electric cars, the Colorado & Southern controlling the Interurban road.

GRAND MEADOW, MINN.—A meeting of the farmers and business men of this vicinity was held at Grand Meadow to listen to the proposition regarding the sale of stock in the Dan Patch air line, as presented by Director McCanna, of that company. More than $11,000 was subscribed for stock which, with the assurance of additional subscriptions from farmers along the proposed route and the citizens of High Forest, practically guarantees for Grand Meadow the main line of the road.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has filed its annual report with the state board of railroad commissioners. The gross earnings were $1,303,045, as against $999,492 last year. The operating expenses have increased from $719,335 to $911,799. Last year's dividends at eight per cent amounted to $156,672, while this year $168,660 was divided among the stockholders at the same rate. This year's surplus is $4,968, while a year ago it was $2,909.

RICHMOND, VA.—The Fredericksburg & Southern Railway has applied to the state corporation commission for a charter. The line will run from Fredericksburg to Doswell. The capital stock is placed at from $1,000 to $10,000. The officers of the company are: W. C. Whitner, president; E. J. Smith, vice-president; Alvin T. Embrey, secretary and treasurer, and the following directors: William C. Whitner, E. J. Smith, C. W. Jones, A. P. Rowe, James T. Lowery, A. W. Embrey and Alvin T. Embrey.

PROVIDENCE, R. I.—At the annual meeting of the stockholders of the Providence & Worcester Railroad Company officers and a board of directors were elected. After the regular business was transacted the following officers were elected: President, Walter F. Angell; treasurer and clerk, William A. Leete. Board of directors, G. Marston Whitin, Whitinsville, Mass.; A. George Bullock, Worcester, Mass.; Waldo Lincoln, Worcester, Mass.; Walter F. Angell, Providence; Samuel S. Durfee, Providence; Lincoln Davis, Boston; Frank W. Matteson, Providence.

LIDGERWOOD, N. D.—At a meeting held at Veblen recently for the incorporation of a traction company to construct an electric line from Veblen to Lidgerwood, a corporation was organized with a capital of $500,000, with E. A. Movius and J. H. Movius, of this city; B. P. Hammerstad, Aaron Anderson, Ole P. Akre, J. B. Holsey, H. J. Hanson, P. L. Peterson and George F. Anderson as the first board of directors. Arrangements for a survey will be made at once. There is a large freight and passenger business to be handled by the line as soon as it is ready for traffic.

CHARLESTON, S. C.—At a meeting of business men the project of constructing and operating an electric railway between Charleston and Summerville was endorsed and a committee was appointed to cooperate with the promoters in securing the building of the road by the reorganized Charleston-Summerville Electric Railway Company. The city council recently granted the petition of the company for an extension of its franchise for two years from December 23, 1907, conditioned, however, upon the company giving a practical demonstration of progress in construction within the coming six months.

HARRISBURG, PA.—The charter application of the West Chester & Wilmington Electric Railway Company, with a capital of $54,000 and headquarters at West Chester, has been approved by Governor Stuart. The company will build a line from West Chester to the state line between Pennsylvania and Delaware through West Goshen, Westtown, Thornburg and Birmingham, Chester county, and Birmingham and Concord townships, Delaware county. Thomas E. O'Connell, of West Chester, is president and a director of the company. Other directors are: C. P. Faucett, Westtown township; James A. Kirkpatrick, Birmingham; Charles Gleason, Brandywine Summit; Wills Passmore, Brandywine; F. Harvey Day, Talleyville, and M. A. O'Connell, West Chester.

FOND DU LAC, WIS.—A crew of surveyors is at work on the proposed Fox River Valley line, in the neighborhood of Cedarburg. Although this line will be built independently of the proposed interurban line from Fond du Lac to Appleton, promoted by John M. Saemann, of this city, it will be a part of the same system. The Fox River Valley line is to be built from Milwaukee to Cedarburg and Fond du Lac and connect with the new interurban line which will run from Fond du Lac, through Taycheedah, Peebles, Calumet Harbor, Calumetville, Stockbridge, Brothertown, Clifton, Sherwood and then to Appleton. The survey for this section has already been completed and is for a direct line from Fond du Lac to Appleton around the east shore of Lake Winnebago.

SPRINGFIELD, ILL.—At a meeting of the stockholders of the proposed St. Louis, Terre Haute & Quincy electric line it was decided to remove the headquarters of the company from this city to Quincy. Some amendments were also made in the by-laws of the company. Quite a number of the stockholders and directors of the road were present and new directors were elected. The new directors are: Edwards Yates, of Springfield, president; H. C. Simons, of Virden, vice-president; F. W. Kollenberg, of Quincy, secretary and treasurer. Other directors of the proposed road are: F. W. Fick, of Quincy; S. P. Landerast, of Quincy; J. A. Wible, of Kansas City; J. E. Hogan, of Taylorville; J. F. Fullbrucker, of Quincy; Elba Williams, of Pittsfield; W. N. Huffman, of Baylis; J. A. Cheney, of Taylorville, and Loren C. Cox, of Quincy. The promoters are confident that the road will become a reality.

PORTLAND, ORE.—Articles of incorporation for the Portland, Eugene & Eastern Railway Company, which were prepared in Salem, have been filed with the county clerk. The articles state that the company is organized with a capital stock of $1,000,000 for the purpose of building a system of railways from Portland south through Salem and Albany to Eugene, and from Eugene east to Springfield, thence up the Mackenzie river valley, and through Primeville to connect with the Oregon Short Line at Ontario, in Eastern Oregon. Branch lines to be built from Eugene to Florence and to Cottage Grove and Corvallis; also from Salem east to Mehama, and west from Salem through Dallas to Yaquina City on the coast. The company is authorized to use steam, electricity, gas, compressed air or any other manner of generating motor power, and to build steamships, wharves, deal in real estate and timber land, and exercise all other rights usually exercised by railroad corporations. The incorporators are: J. A. Storey, J. C. Bracher, A. V. Welch, E. W. Hall, G. Bracher and John H. McMurray

INDUSTRIAL ITEMS.

THE COLUMBIA ELECTRIC METER COMPANY, 36 West South street, Indianapolis, Ind., will be pleased to send descriptive literature describing its type "A" direct or alternating-current meters.

THE PHILIP CAREY COMPANY, Cincinnati, Ohio, has published a handsome catalogue devoted to carbonate of magnesia and asbestos coverings for engineering auxiliaries. This catalogue is replete with interesting information concerning practical applications of this material, and will be sent to any one interested upon request.

THE CLING SURFACE COMPANY, 1032 Niagara street, Buffalo, N. Y., has issued a very interesting and instructive booklet entitled "The Treatment of Belts and Ropes for Service and Profit." This takes up in detail the treatment of belts of all kinds of fibre, and will be found of particular interest to superintendents, engineers or belt men.

PARKER & LEE, 20 Broad street, New York city, announces that the firm will be dissolved on December 31 by the retirement of Ivy L. Lee. The business will be continued at the same address, George F. Parker, for this purpose, having associated with himself Charles A. Bridge, hitherto manager, under the firm name and title of Parker & Bridge.

THE PENNSYLVANIA RAILROAD COMPANY, New York city, announces that it will continue the policy inaugurated of furnishing to the public prompt and accurate information of interest relative to its affairs, and that Ivy L. Lee, who retires from the firm of Parker & Lee on December 31, will, on January 1, 1908, enter the service of the Pennsylvania company, to have particular charge of the work of publicity, which the firm of Parker & Lee has hitherto conducted.

THE EDWARD E. CARY COMPANY, 59-61 Park Place, New York city, is the sole importer of "Fabius Henrion" carbons. These carbons are made for direct-current enclosed and open arc lamps, for alternating-current arc lamps, and for moving-picture-machine lamps. The carbons are also very popular for use with flame arc lamps. The carbons are also very popular for use with flame arc or white light. The company will be pleased to submit full information upon request.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued two new booklets entitled, respectively, "The Exide Battery Book," of interest to users of electric vehicles, and "The Exide Sparking Battery Instruction Book," giving instructions and information applying to the 1908 model "Exide" sparking battery for gasolene vehicles. These booklets will be forwarded upon application to any of the sales offices of the Electric Storage Battery Company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., will be please to send bulletin No. 1203, entitled "Allis-Chalmers Rolling Mills," to any one interested. This contains valuable data on a type of bearing for fast-running machinery which has been developed by the Allis-Chalmers Company. The bearings described are self-aligning, are housed the same as the journals of an electric generator, are kept perfectly clean, and will not spill oil. The company states that positive lubrication is assured at all times and that the oil will not foam at any speed.

THE R. E. HARDY COMPANY, 86 Watts street, New York city, announces the placing on the market of two new spark plugs. The first is called the "Gotham Sta-Rite," and its chief feature lies in an extended shell partly closing the inner end and protecting the porcelain from heat, oil or soot. The porcelain has a single hollow tube packed with copper asbestos-filled gaskets, which can not become wedged. The other plug is called the No. 4A magneto plug, and the insulated electrode has an enlarged head equipped with four points, any one or more of which will serve as a jumping point for the spark.

THE RAIL JOINT COMPANY, 29 West Thirty-fourth street, New York city, is the largest producer of rail joints in the United States, and the application of its product to both steam and electric railroads is growing in popularity all over the world. During 1907 the output of the company was in excess of any previous year. The total quantity shipped for steam and electric railroads to date is more than sufficient to equip a railroad that would encircle the earth. From present indications the outlook for business for the coming year is good, and the company is hopeful of continuing its large output during 1908.

THE ATWATER KENT MANUFACTURING WORKS, Philadelphia, Pa., conducted an endurance test of the Atwater Kent spark generator for ignition purposes, at the recent Chicago automobile show, held at the Coliseum. The demonstration outfit included six "Columbia" dry cells, four spark plugs and a Jones speedometer-odometer. The whole apparatus was sealed in a glass cabinet and run by an electric motor. At the beginning of the test the batteries showed an average of four and one-half amperes. On unsealing the cabinet the batteries were found to test to an average of three amperes, having lost only one and one-half amperes in over 1,000 miles. The spark generator was in perfect condition, and on inserting fresh cells, regular sparks were obtained without readjustment.

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The S. S. Grady Company, Limited, of Boston, has been incorporated with a capital of $3,000 to deal in electrical machinery. Stephen S. Grady, Boston, is president, and Herbert G. Perry, of Rockland, is treasurer and clerk.

BOSTON, MASS.—The Matanzas Company, of Boston, has been incorporated with a capital of $50,000 to engage in the manufacture of telephones. The officers are: President, Archie N. Frost, Lawrence; treasurer, James L. Miller, Boston; clerk, William F. Howard, Boston.

Record of Electrical Patents.

Week of December 17.

873,702. ALTERNATING-CURRENT MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. A motor with distributed windings and means for varying the number of poles of each element.

873,703. ELECTRICALLY PROPELLED CAR OR LOCOMOTIVE. Edward H. Anderson, Schenectady, N. Y., assignor to General Electric Company. A combination of a motor-generator and a group of series motors.

873,706. MOTOR TRUCK. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Company. The truck forms part of the magnetic circuit of the motors.

873,714. DYNAMOELECTRIC MACHINE. Joseph L. Burnham, Schenectady, N. Y., assignor to General Electric Company. A machine with divided poles.

873,715. ELECTRICAL ACCUMULATOR. Charles Busch, New York, N. Y. Diaphragms are used, the openings being filled with capillary material.

873,721. TRANSFORMER. Jesse Coates, Lynn, Mass., assignor to General Electric Company. A design of transformer core.

873,729. THROTTLE-RELAY. Archibald S. Cubitt, Schenectady, N. Y., assignor to General Electric Company. Two coils, one in series and one in shunt with the motor, control a throttle-relay.

873,737. AUTOMATIC CUT-OUT FOR ELECTRIC CONTROLLERS. Arthur C. Eastwood, Cleveland, Ohio. A magnetic circuit-breaker.

873,741. SWITCH-OPERATING MECHANISM. Edwin E. Frederick, Bellevue, Pa., assignor to the Frederick-Elder Company, Incorporated, Pittsburg, Pa. A switch.

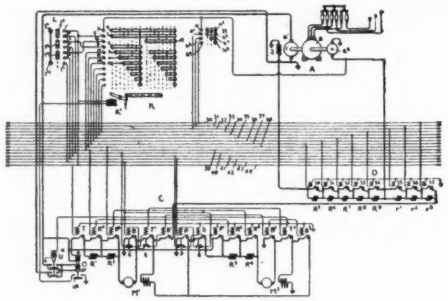
873,751. CONDENSER. Nelson S. Hopkins, Fort Wayne, Ind., assignor to General Electric Company. A split condenser.

873,757. TRANSMITTING DEVICE FOR ELECTRIC TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Means for connecting either of two sources of current to the line.

873,778. DYNAMOELECTRIC MACHINE. Karl A. Pauly, Schenectady, N. Y., assignor to General Electric Company. A generator with means for adjusting the time-lag of the field circuit.

873,780. INSULATED COIL. Charles F. Peterson, Schenectady, N. Y., assignor to General Electric Company. A coil of insulated wire, the insulation of which is burned off and replaced by heat-proof material.

873,793. SAFETY-FUSE INDICATOR. Caroline N. Sachs, Hartford, Ct. A wire in the cartridge is broken when the fuse blows.



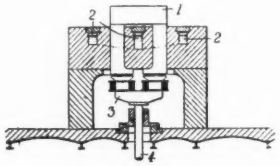
873,703.—Electrically Propelled Car or Locomotive.

873,804. ELECTRIC LIGHTING. Elmer A. Sperry, Brooklyn, N. Y. Means for agitating a metallic-filament lamp so as to weld a broken filament.

873,805. CONTROLLER. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company, and the Bullock Electrical Manufacturing Company. The controller shaft forms part of the magnetic circuit for the blow-out magnets.

873,815. SWITCHING DEVICE FOR ELECTRIC MOTORS. John B. Wiard, Lynn, Mass., assignor to General Electric Company. A centrifugally actuated motor-switch.

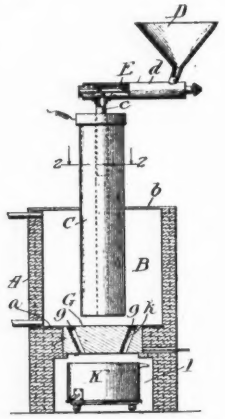
873,846. CARTRIDGE-FUSE ATTACHMENT-PLUG. Robert A. Cultra, Cambridge, Mass. A fuse attachment for extension plugs.



873,861.—Electric Furnace.

873,861. ELECTRIC FURNACE. Gustaf Holmgren, Westerås, Sweden. An induction furnace.

873,890. ELECTRIC SMELTING FURNACE. William R. Parks, Chicago, Ill., assignor to Samuel Shaw Parks, Chicago, Ill. Openings in the two electrodes provide paths for charging and discharging the furnace.



873,890.—Electric Smelting Furnace.

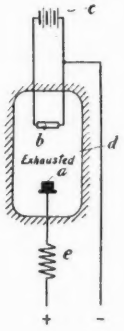
873,935. ELECTRICAL ALARM SYSTEM. William N. Fawcett, Brooklyn, N. Y., assignor of one-half to Max Bernstein, New York, N. Y. A burglar alarm.

873,940. ELECTRICAL CONNECTION FOR HOSE-COUPLINGS. Frederick Hoffman, Cincinnati, Ohio. Rings are provided on couplings.

873,954. SPARKING COIL WITH MULTIPLE WINDING FOR IGNITION AND LIKE PURPOSES. Auguste Michel, Paris, France. A coil having a second winding.

873,955. TROLLEY HEAD. Charles C. McClintock, Englewood, Col. A pivoted trolley head.

873,958. METHOD OF PRODUCING HOMOGENEOUS BODIES FROM TANTALUM OR OTHER HIGHLY REFRACTORY METALS. Marcello von Pirani, Willmersdorf, near Berlin, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. The metals subjected to the electrical arc while in a vacuum.



873,958.—Method of Producing Homogeneous Bodies from Tantalum or Other Highly Refractory Metals.

874,016. TURN-BUTTON FOR ELECTRIC SWITCHES. Henry E. Leppert, New Britain, Ct., assignor to the Hart Manufacturing Company, Hartford, Ct. A method of construction.

874,023. NON-INDUCTIVE RESISTANCE. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. The conductors are wound on insulated supports in opposite directions.

874,024. ELECTRIC BELL. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. An enclosed bell.

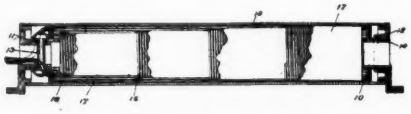
874,025. SYSTEM OF MOTOR CONTROL. Alexander McIver, Schenectady, N. Y., assignor to General Electric Company. Individual switches are closed in automatic progression.

874,118. TELEPHONE TRANSMITTER. Carl J. Printz, Milwaukee, Wis. A receptacle containing disinfectant is attached to the transmitter.

874,147. THREE-WIRE MULTIPLE SYSTEM. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A three-wire telephone system.

874,178. CAUTERY. Lee de Forest, New York, N. Y., assignor to George K. Woodworth, Brookline, Mass. A method of cauterizing by means of high pressure electrical oscillations.

874,209. ELECTRIC TRANSMISSION OF INTELLIGENCE. Isidor Kitsee, Philadelphia, Pa. A conductor is placed in shunt with the return conductor to neutralize the inducing effect of the power wire.



874,023.—Non-Inductive Resistance.

874,242. TROLLEY. Charles M. Rhodes, Steubenville, Ohio. The wheel is allowed axial movement.

874,245. LAMP SOCKET. John J. Rooney, Scarsdale, N. Y. The socket proper is enclosed in a tube which is sealed with insulating material.

874,345. TROLLEY. George Keresztes, Pittsburg, Pa. A wheel with extended sides, conical in shape and grooved.

874,372. ELECTRICAL SIGNALING DEVICE. James P. Williams, Latonia, Ky. A block-signaling system.

874,373. TRACK GAGE. Edgar W. Fordyce, Anniston, Ala. An electric alarm gives warning of variations from the true gage.

874,374. APPARATUS FOR ELECTRODEPOSITING METALS. Wilhelm Müller, Offenbach-on-the-Main, Germany, and Charles R. Murray, Chicago, Ill., assignors to Actiengesellschaft für Schriftgiesserei und Machinenbau, Offenbach, Germany. Means is provided for moving the articles being plated.

ELECTRICAL REVIEW

VOL. LI—No. 2. Registered in United States Patent Office. NEW YORK, SATURDAY, JULY 13, 1907. SINGLE COPIES TEN CENTS. THREE DOLLARS A YEAR.

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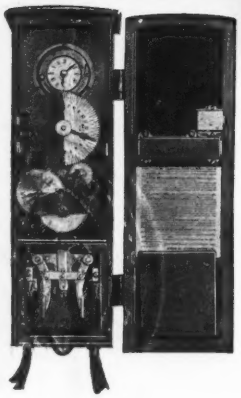

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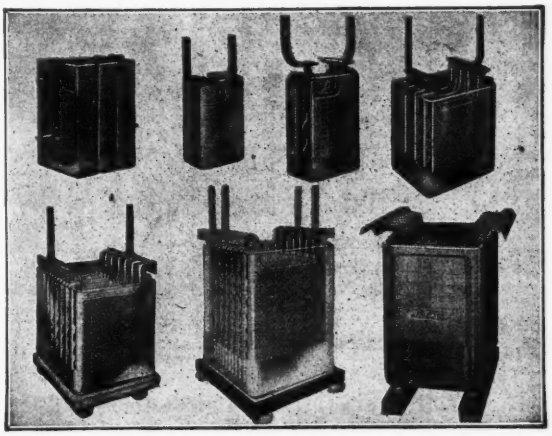

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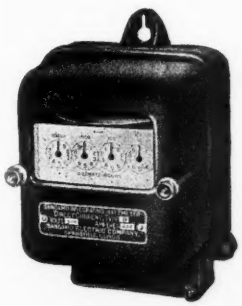

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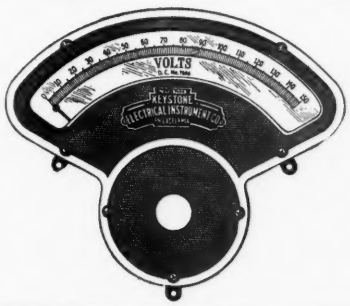

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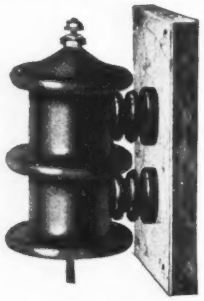

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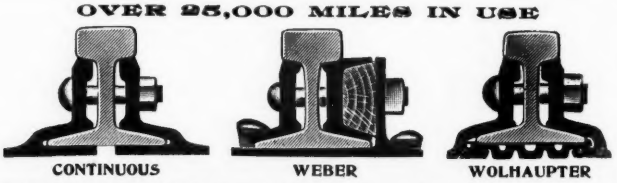

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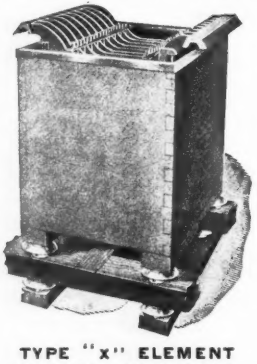

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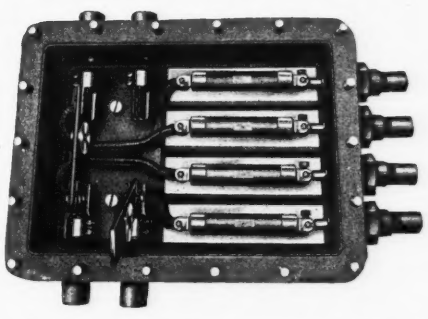

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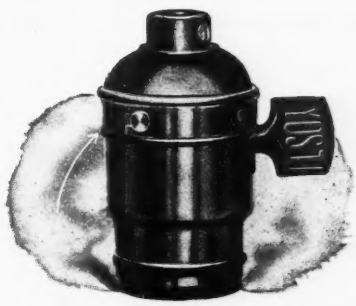

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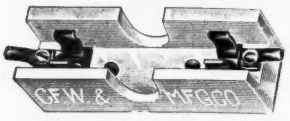

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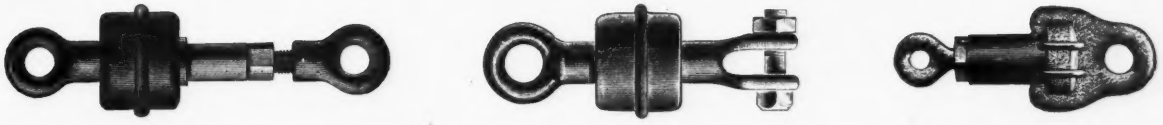

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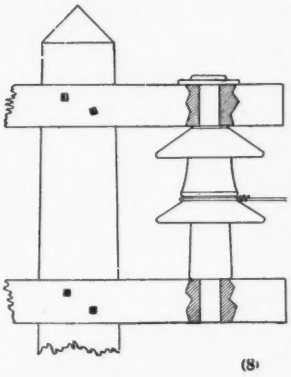

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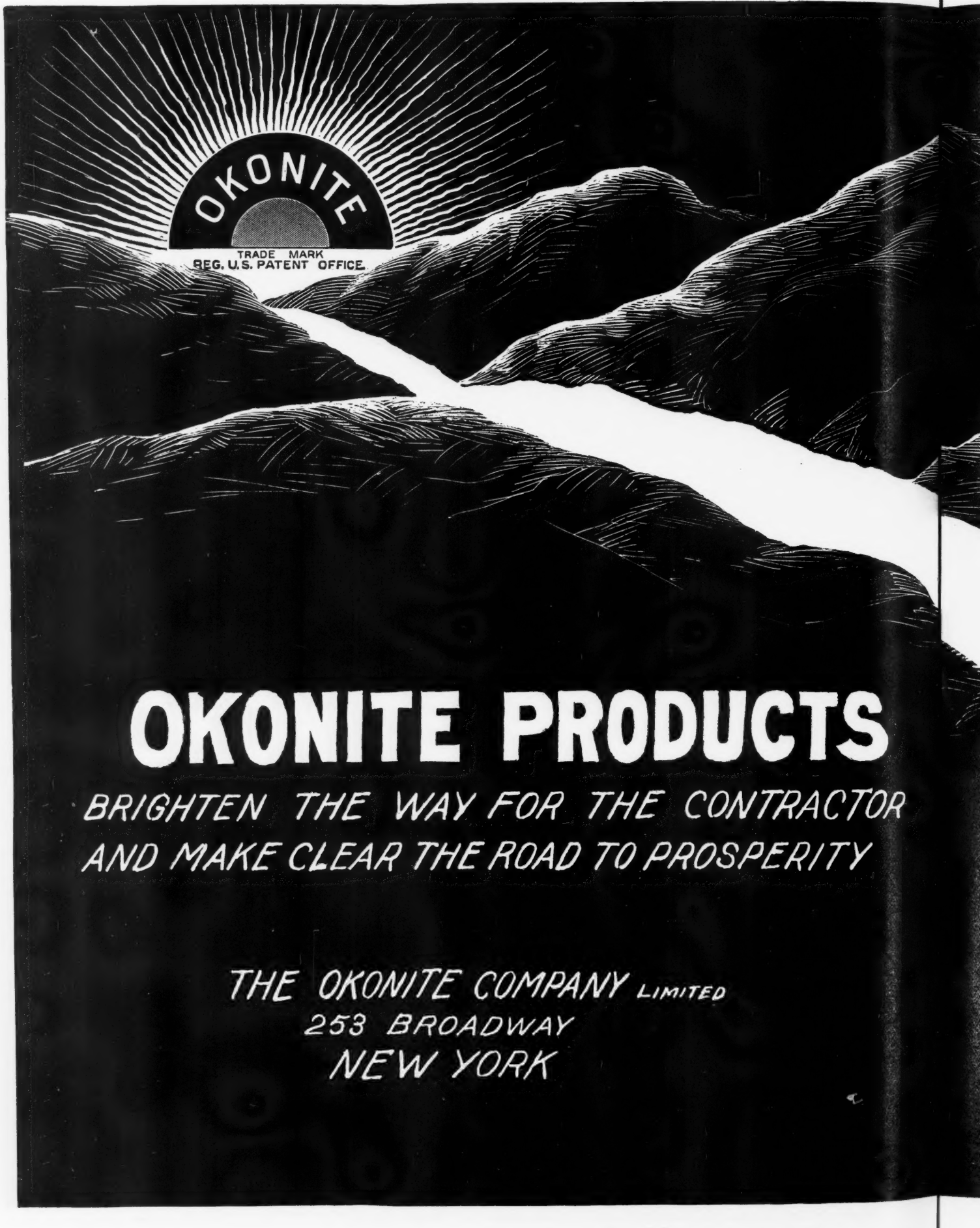
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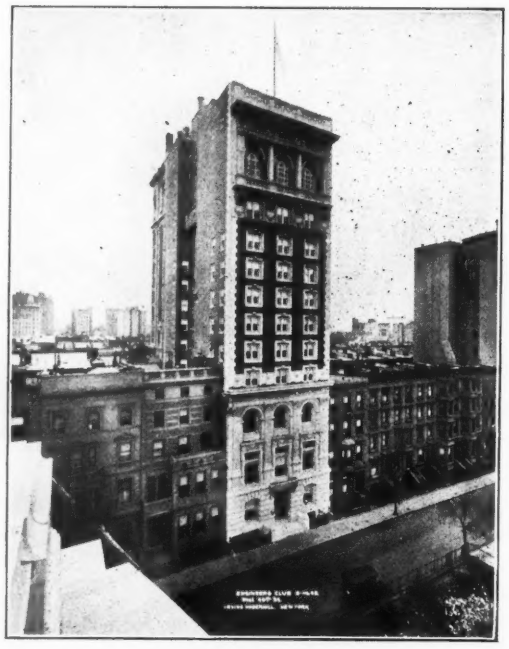

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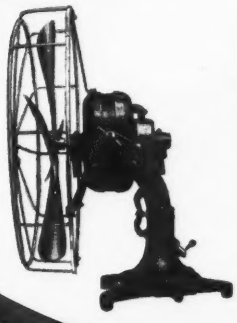

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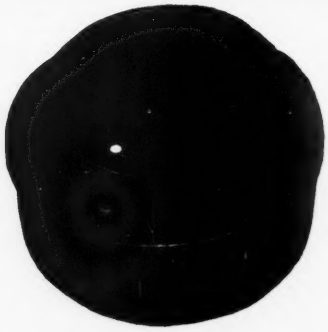

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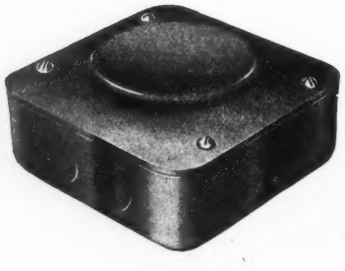

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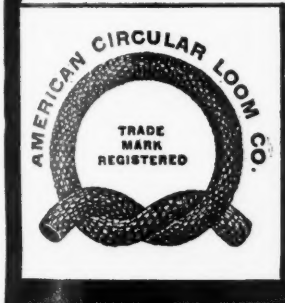

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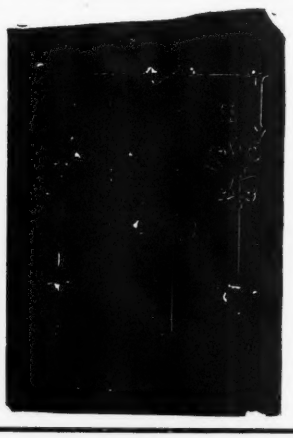

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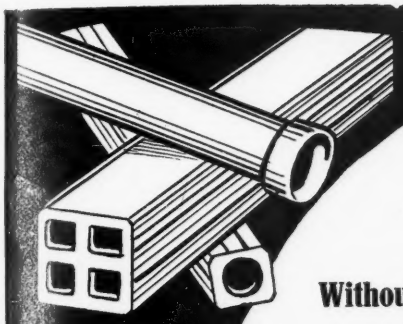

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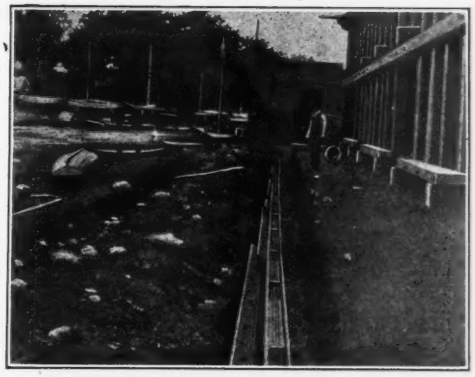

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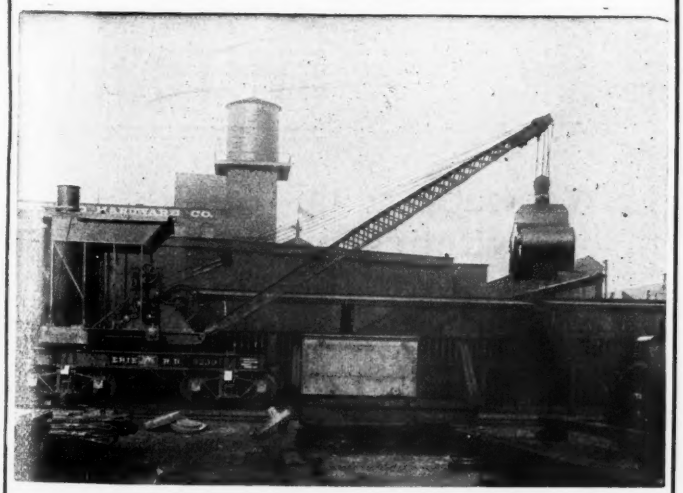

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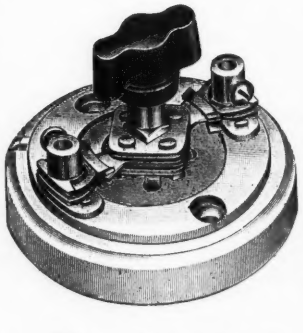

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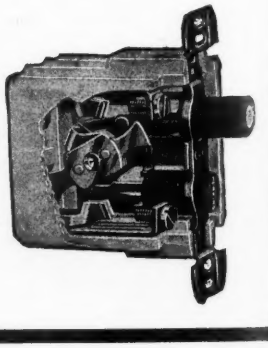

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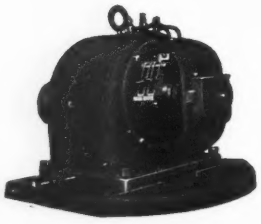

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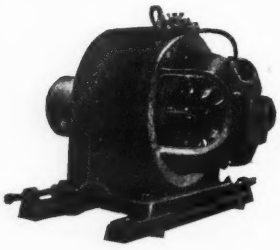

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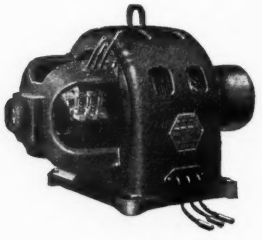

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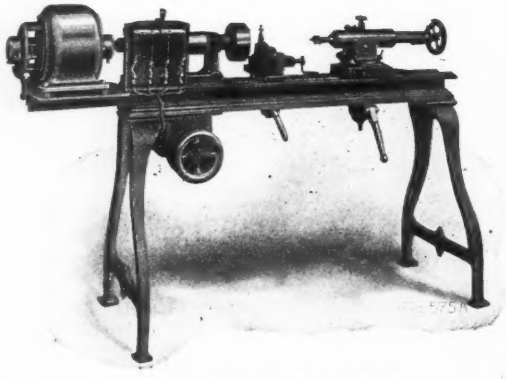

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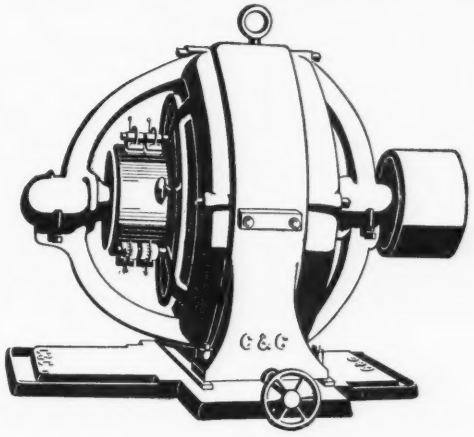

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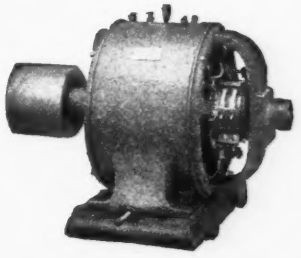

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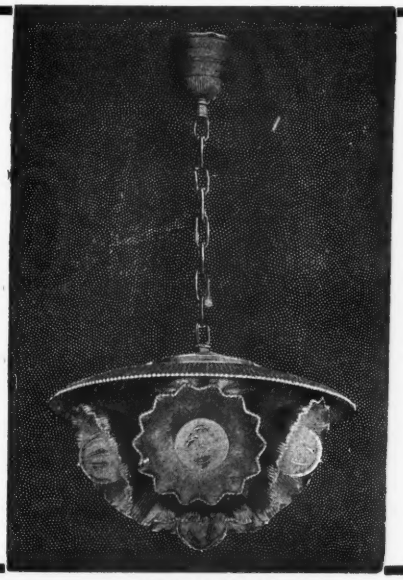

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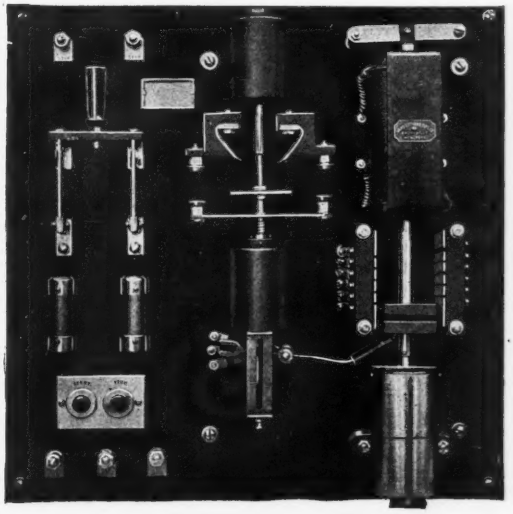

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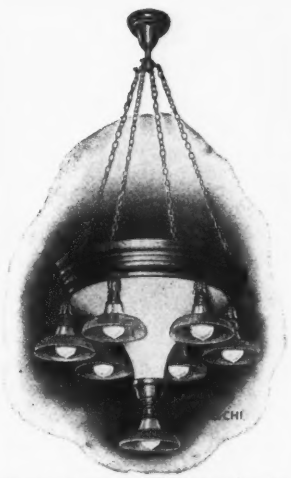

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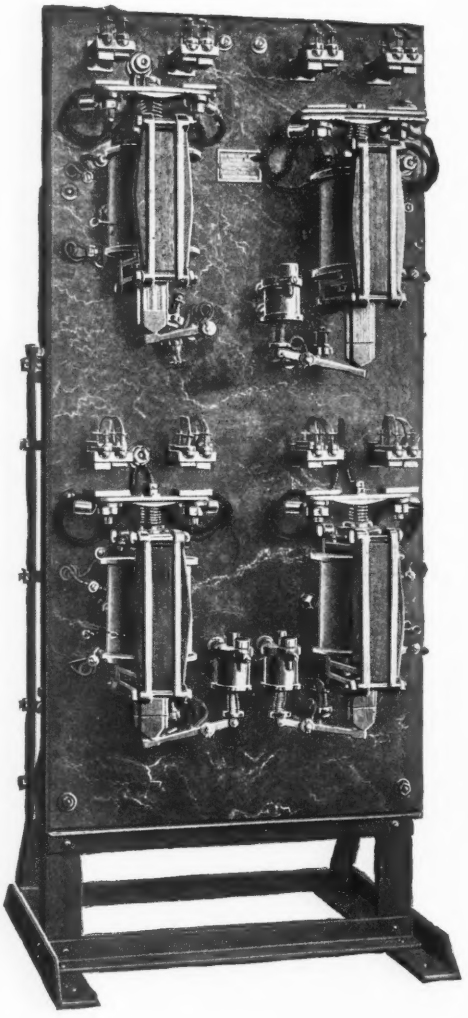

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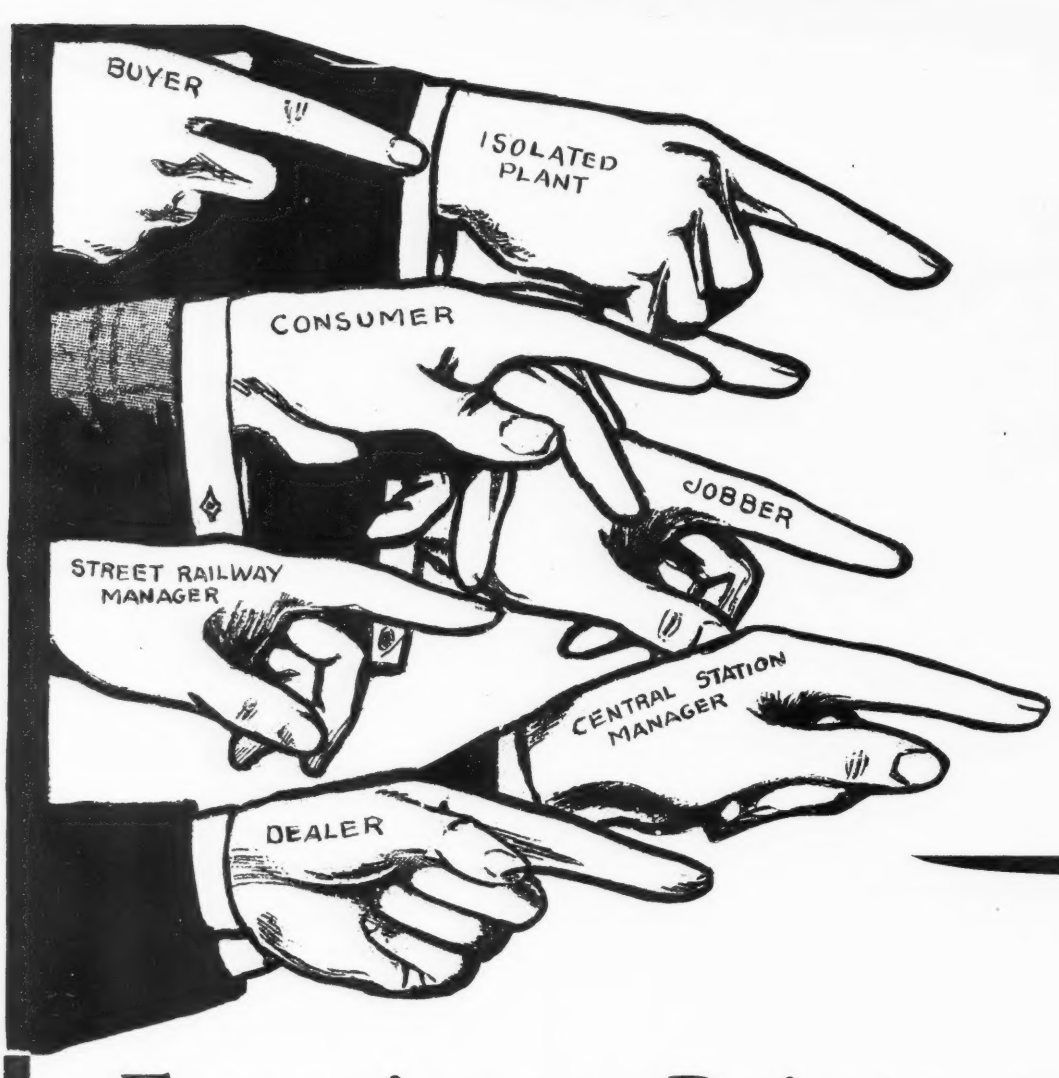

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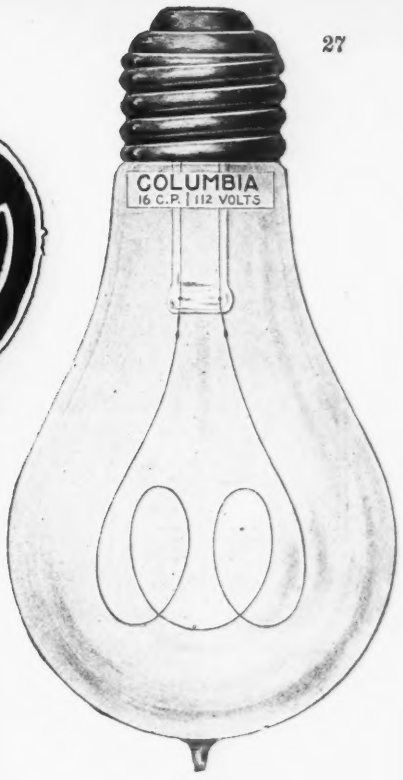

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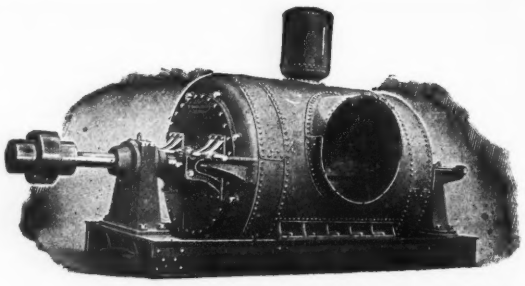

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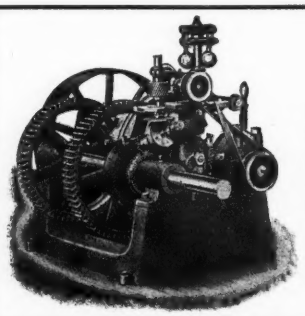

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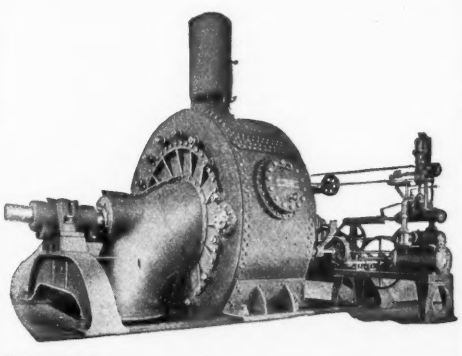

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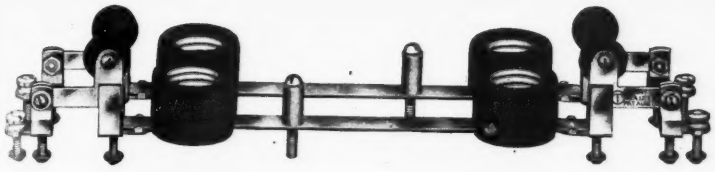

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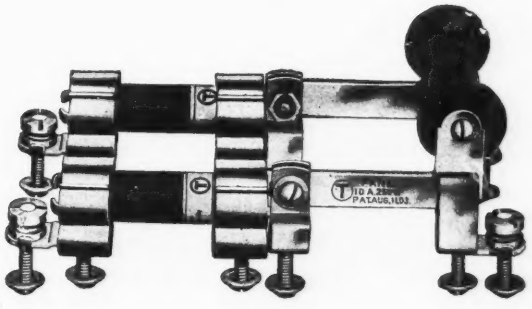

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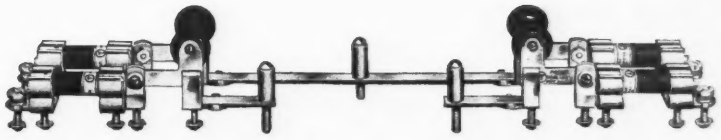

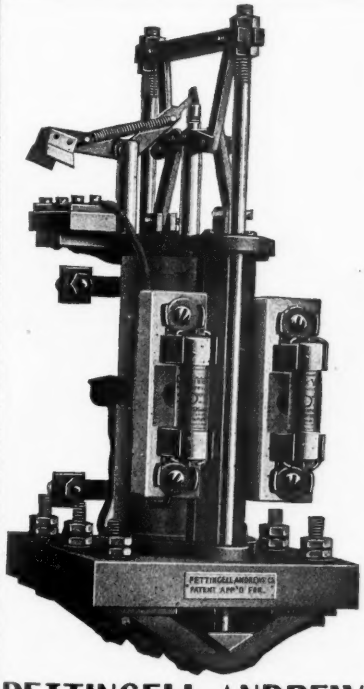

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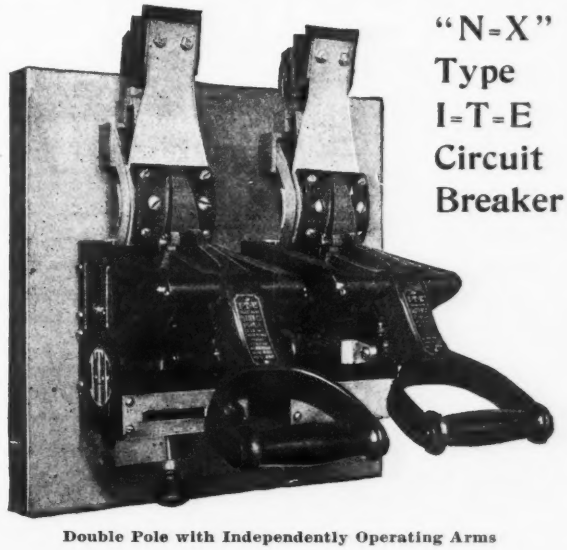

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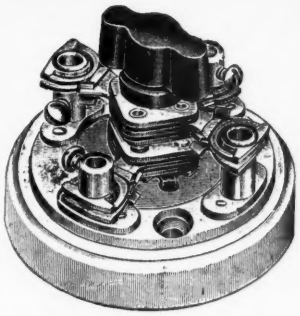

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The Electric Controller & Supply Co.

FLOOR OUTLETS
Steel City Electric Co.

(Continued on page 39)

"Lighting and Illuminating Engineering Number"

SEPTEMBER 14, 1907

Electrical Review

Presenting in a single issue the advanced practice in this great field, which is receiving a rapidly increasing degree of attention. The editors will soon announce a list of especially contributed articles, by men eminent in the theoretical and practical sides of lighting and illuminating, which are in course of preparation for this number.

THE ELECTRIC LAMP— *IN ITS SCORE OF FORMS*

The striking feature of the number will be the substantial section which will contain the first complete publication of the evolution and present accomplishments of all types of electric lamps — the various forms, Carbon Incandescent Lamps, Tantalum Incandescent Lamps, Metallized Carbon Incandescent Lamps, Osmium Incandescent Lamps, Helion Incandescent Lamps, Tungsten Incandescent Lamps, Titanium Incandescent Lamps and the open and enclosed Carbon Arc and Flaming Arc types of lamps, Nernst Lamps, the Mercury Vapor System, Tube Lighting; with the addition of particular adaptations of these several forms — with technical data bearing on their most successful applications, written by men who are devoting their lives to this great field of advancement.

OF TECHNICAL, SCIENTIFIC AND COMMERCIAL INTEREST

It is the purpose of the editors to have these contributed articles of purely technical and scientific value, yet of such a nature as to prove of great interest to illuminating engineers and the operators of electric light plants.

In addition to the publication as outlined above, space will be devoted in this number to phases of the commercial side of the electric lamp industry and in which illustrations of the newer lamps and apparatus bearing directly on them will appear. This feature will prove of interest to the jobbers and supply houses.

THE PROGRESS IN ENGINEERING CENTRAL STATION PRACTICE

In a comprehensive manner, the progress in central station practice in its various branches will be given readers of this number. Special attention will be devoted to such subjects as central station practice, turbine construction and service, modern generators and engines, boiler installations, advanced features in steam equipments, and general station economies.

AUTHORITATIVE, COMPREHENSIVE YET CONCISE INFORMATION FOR ILLUMINATING ENGINEERS

Growing out of a suggestion by a prominent authority to present a condensed analysis at this time of the attributes and characteristics of the newer forms of electric lamps, together with other matters of interest to central station operators and engineers, this "Lighting and Illuminating Engineering Number" of the ELECTRICAL REVIEW will be published at the beginning of the lighting season, September 14, 1907.

Electrical Review

13 Park Row, New York

1513 Manhattan Building
Chicago

10 Post Office Square
Boston

42 Old Broad Street
London, E. C.

July 13—1907

a Personal note to Contractors

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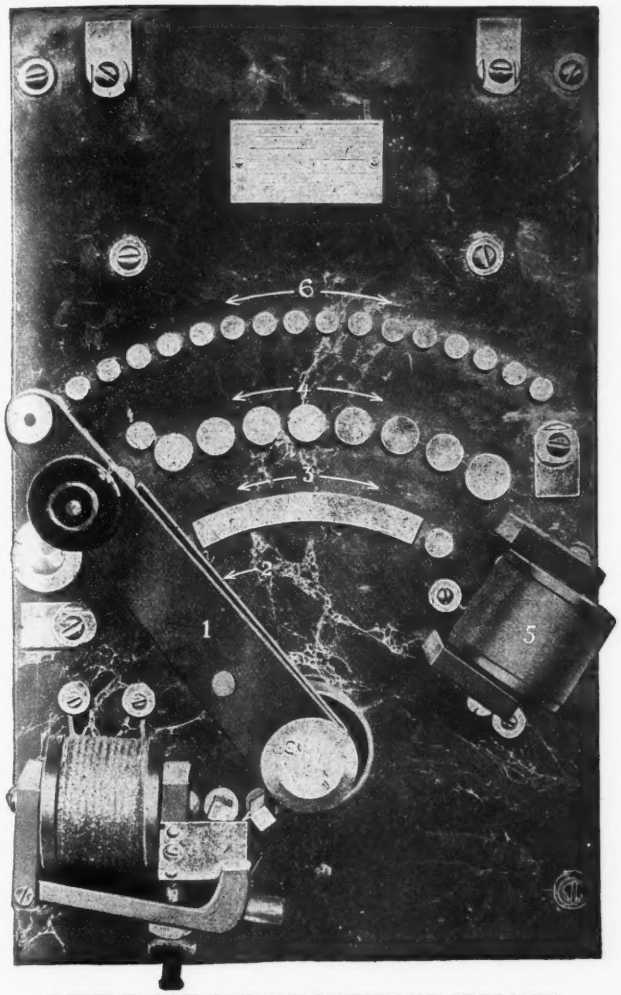

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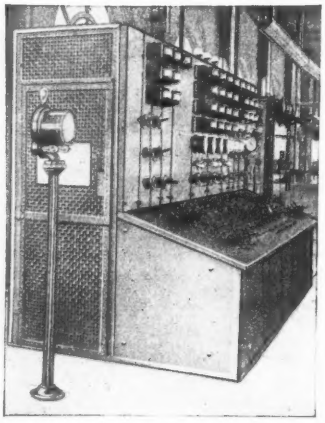

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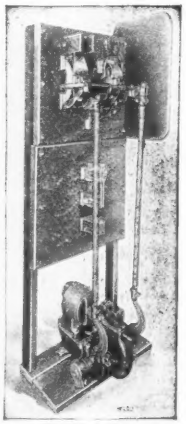

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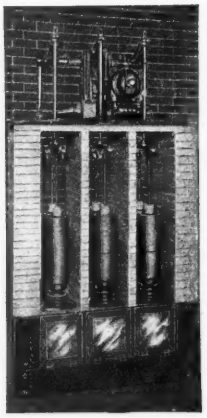

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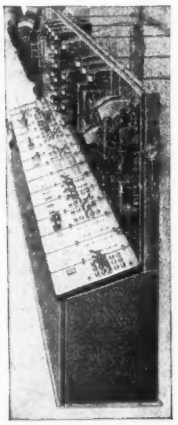

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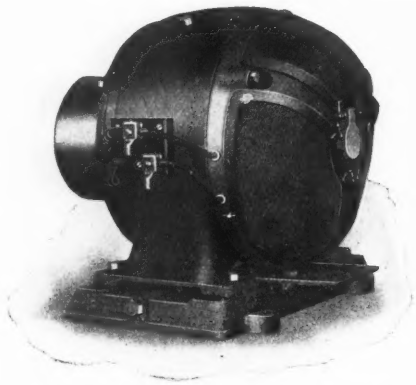

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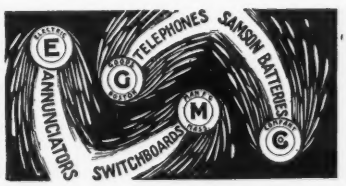

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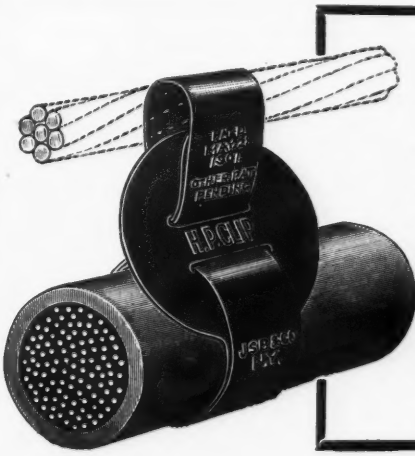

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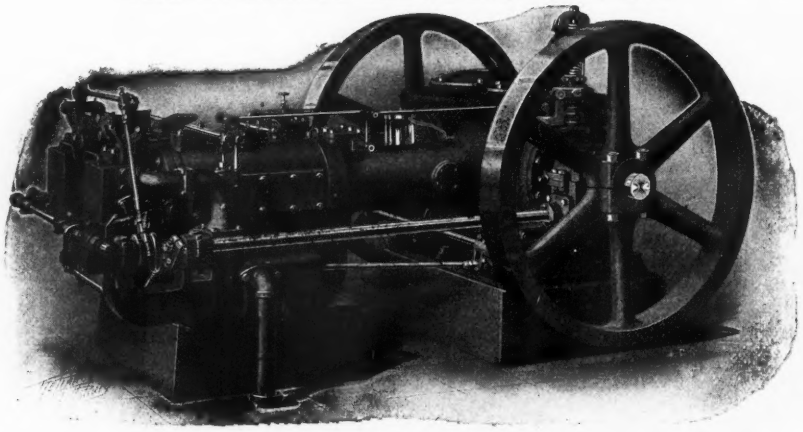

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(*Continued on page 63*)

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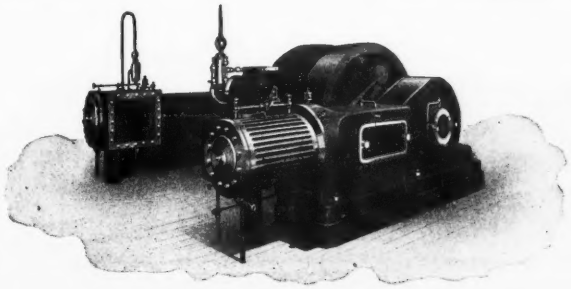

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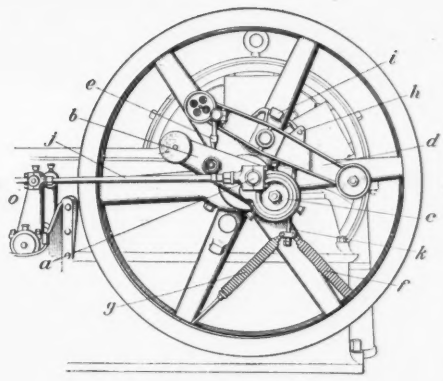

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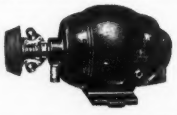

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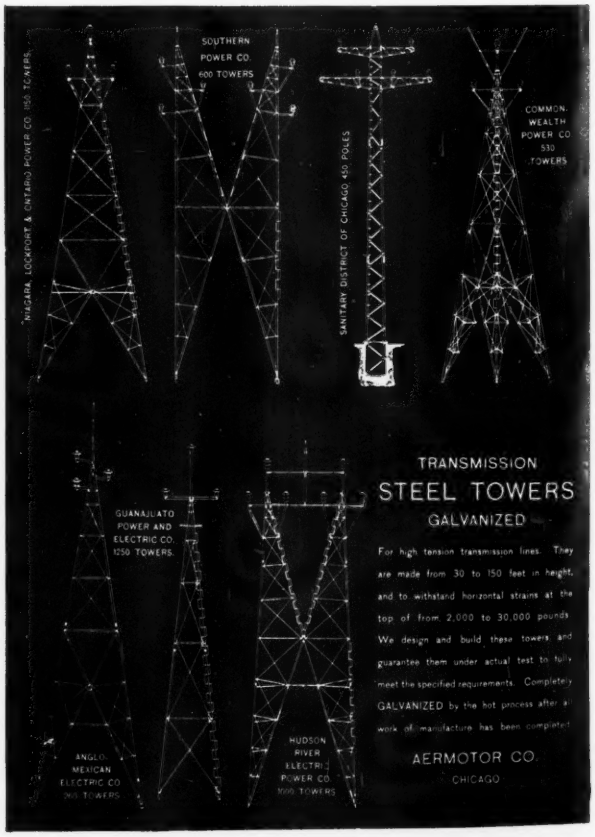
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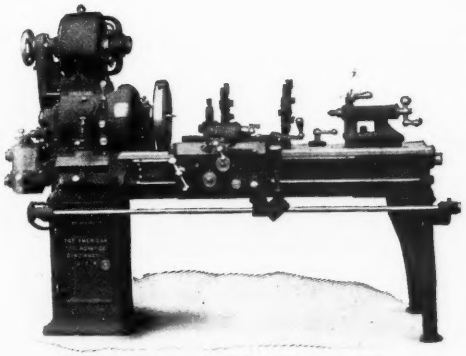

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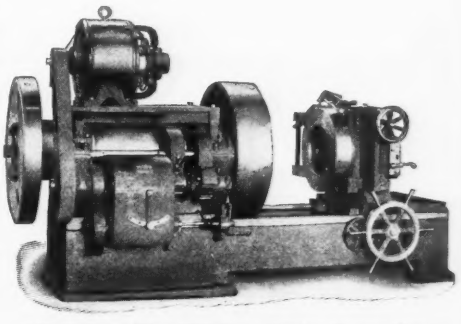

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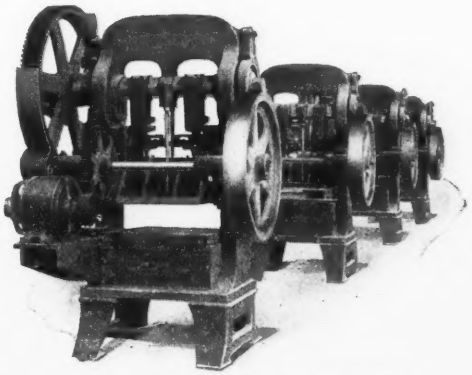
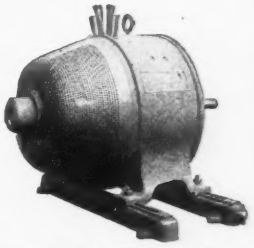
Allis-Chalmers Type "K" Motor



Toledo Punch Presses driven by Allis-Chalmers Type "K" Motors



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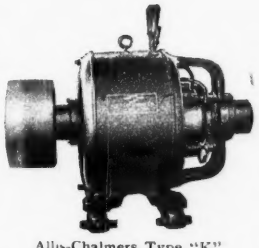

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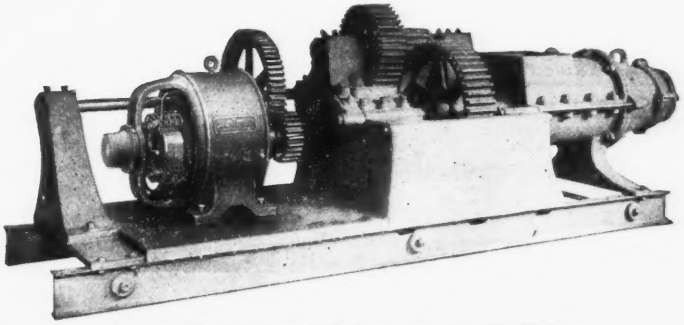

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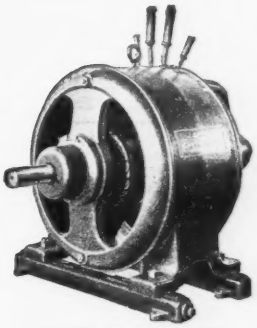

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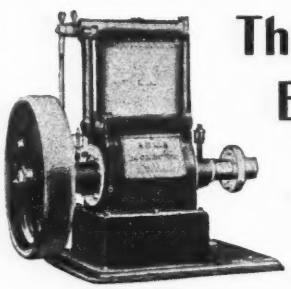

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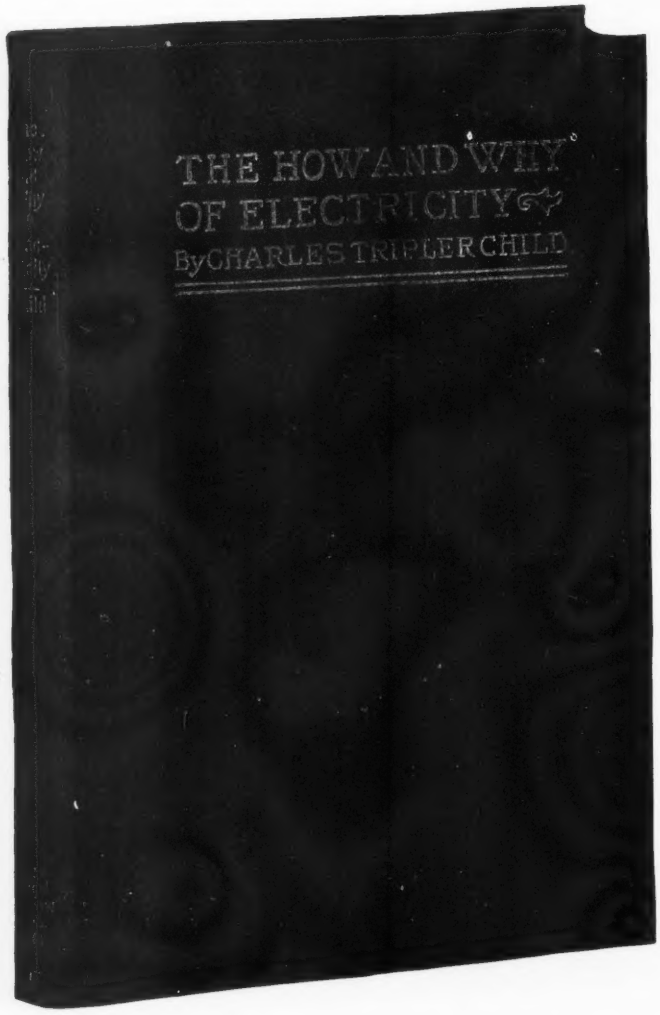

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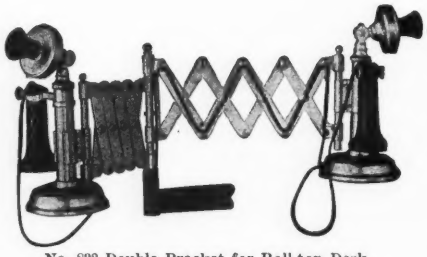

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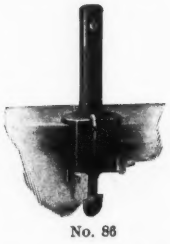

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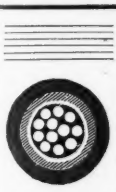

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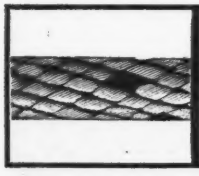

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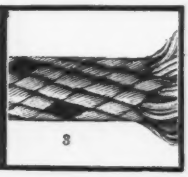

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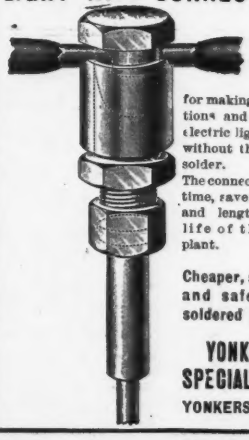

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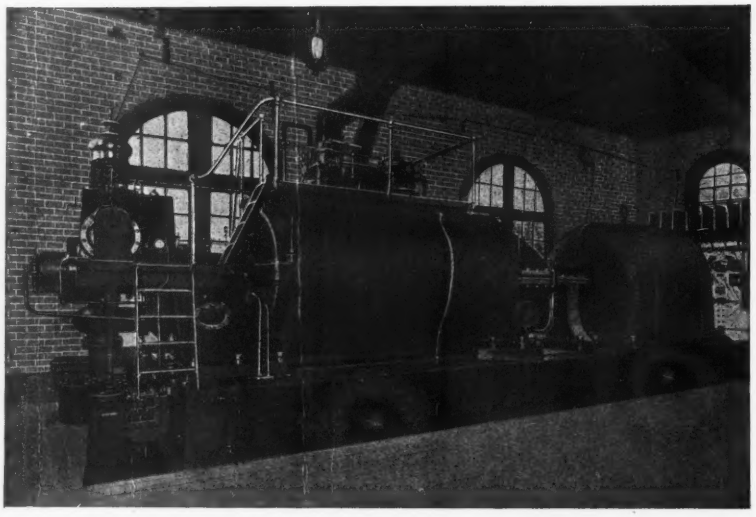

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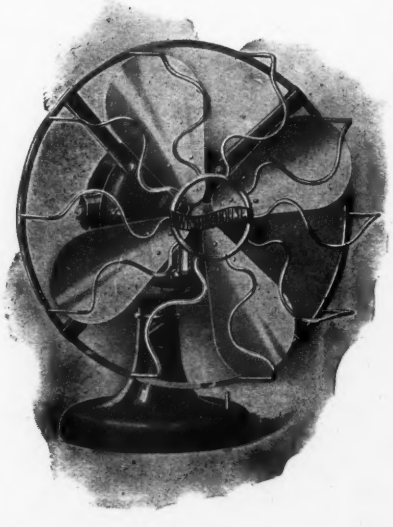

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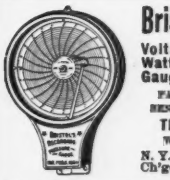
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All Wires Are Tested at Factory.
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Anderson's Electric Time Switch can be relied upon to do its work faithfully and you will find it economical.

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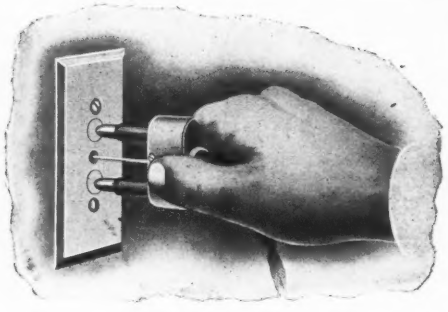
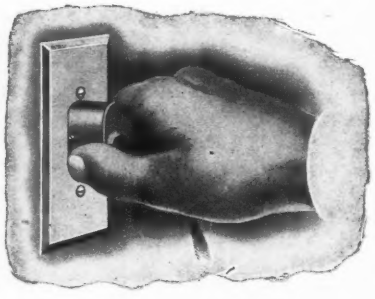


FLUSH RECEPTACLE
WITH PLUG READY TO INSERT



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"Diamond H" receptacles remove all doubt as to safety and convenience. They open and close automatically by inserting or withdrawing plug. Cannot ground or short circuit. No lids to pry open. No tools required.

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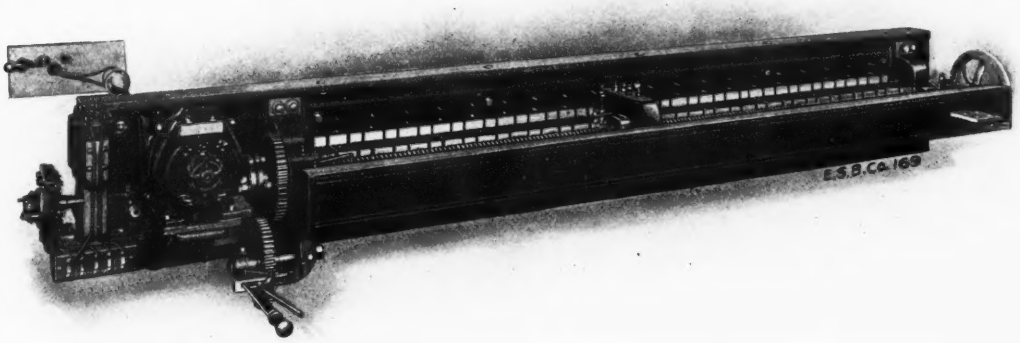

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FOR USE WITH THE

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IT IS THE ONLY LAMP THAT ANYBODY EVER BUYS AGAIN. IT IS WEATHERPROOF, EASILY TRIMMED, AND INNER AND OUTER GLOBES ARE EASILY REMOVED.

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Send for Catalogue No. 14, describing all our A. C. and D. C. Switchboard and Portable Instruments.

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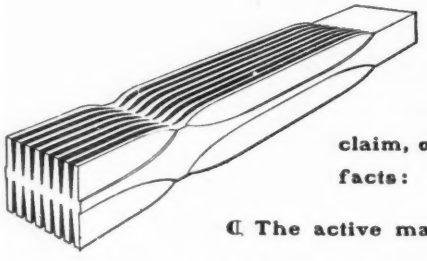
Storage Battery Durability



¶ The practical and economical value of a storage battery depends absolutely upon the life of its plates, and the constructional features embodied in the Gould Plate, when compared with all others of similar types, show that it has an exceptionally long life. The proofs of this claim, open to the most severe investigations, is substantiated by the following facts:

¶ The active material exposes the greatest surface to the electrolyte.

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¶ The ribs hold the active mass so tightly, that it is rarely dislodged.

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"	1897 ..	15,085
	Gain	158,889

Measured Service was introduced March, 1897. Over 90% of the Stations gained during the past ten years are Measured Service. 8,448 Stations gained during the first three months of this year, of which over 92% are Measured Service.

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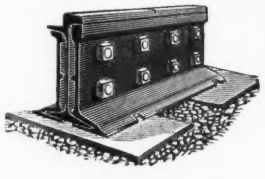

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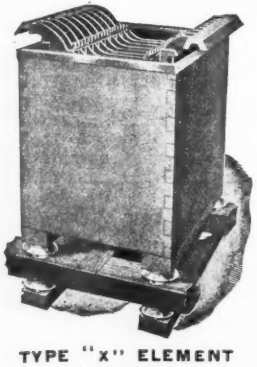
Unit Accumulator



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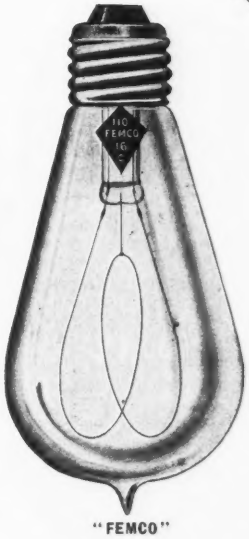

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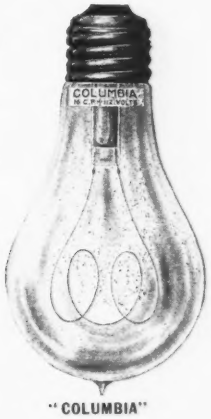

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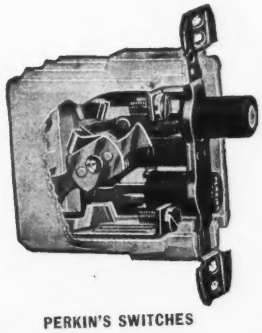
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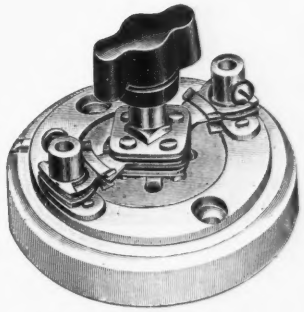
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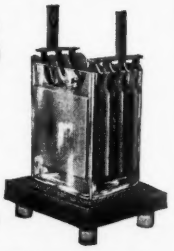

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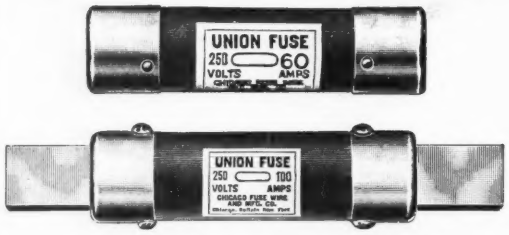

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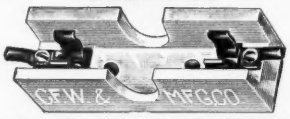

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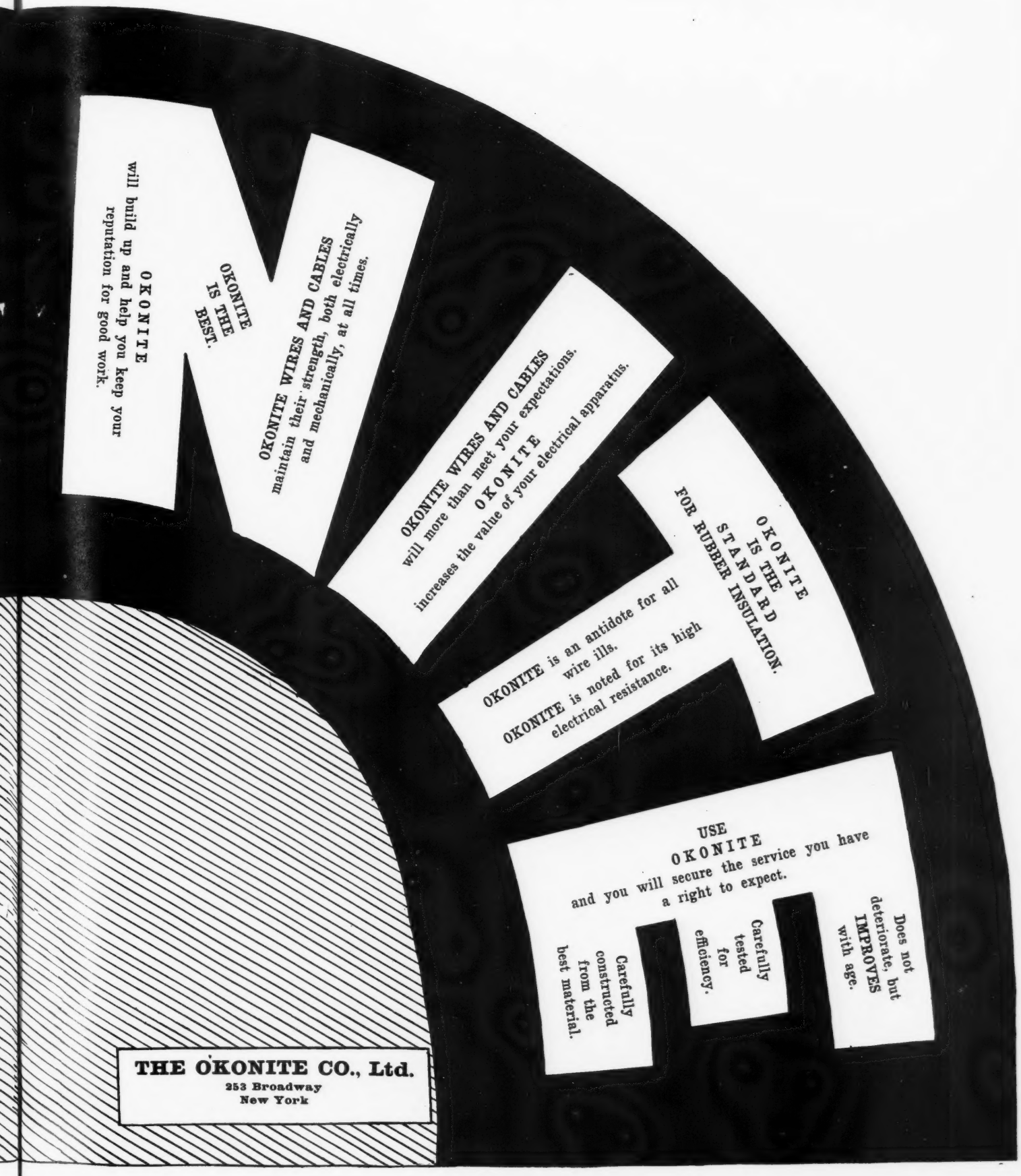
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¶ We originated the snap lock.
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¶ See that bead under the cap edge?
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¶ Better get full particulars.

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Beside our regular switchboard and portable instruments, which are so well known, we show our new Long-Scale switchboard instruments, and also a complete line of new standard ammeters and voltmeters for the most exacting laboratory work.

CATALOG 65 is conveniently arranged and contains much valuable information; it is well worth having, and we want every user of instruments to have a copy.

If you have not received illustrated Catalog 65, write for it at once.

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Its saving is easily proved. It has been successfully used in buildings of all kinds, from modest dwellings to costly public edifices.

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¶ We have an interesting proposition which it will pay you to investigate at once, as the plan is only operative until October 5th.

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ST. PAUL
(American Electric Co.)

SAN FRANCISCO
(California Electrical Works)
LOS ANGELES
(California Electric Co.)
SEATTLE

ONE THIRD

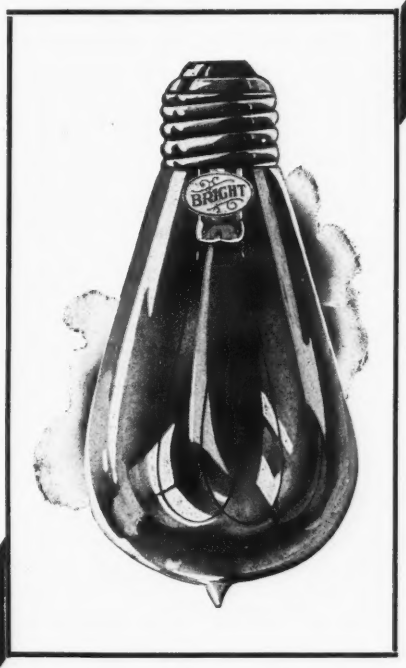
of your Lamp Bills Saved by using

BRIGHT

RENEWED

LAMPS

THEY'RE JUST AS GOOD AS ANY NEW LAMP MADE.



As carefully made
Of the same material
By the same processes
As rigidly inspected
And uniformly good

LOOK FOR THE LICENSE LABEL

They Satisfy your Customers

Try a Sample Case

The Economy Electric Co.

Warren, Ohio

A REMINDER

For Central Station Managers

MAYBE YOU DID NOT SEE OUR LAST ANNOUNCEMENT, JUNE 1.

If you did, you have probably neglected to write us about our original *revenue-producing proposition* for Central Stations.

AGAIN WE SAY

You may give free renewals of 4, 8 or 32-C. P. lamps and receive the same percentage of revenue on your investment as you do on a 16-C. P. lamp.

AGAIN WE SAY

THE NEW STERLING SPECIAL 8-C. P. LAMP has been rated on a logical basis and will live long enough to consume as many K. W. hours during its life as a 16-C. P. lamp, the cost of the 8 and 16-C. P. lamps being the same.

THE NEW STERLING SPECIAL 32-C. P. LAMPS are designed to consume during their life a little less than twice the K. W. hours consumed by a 16-C. P. lamp. This is because the cost of a 32-C. P. lamp is not quite twice the cost of a 16-C. P. lamp.

AGAIN WE SAY

With these lamps you can decrease your expenses and increase your income on the 8-C. P. lamp and decrease the expense to the consumer on our 32-C. P. lamp. It makes no difference whether you renew 8, 16 or 32-C. P. lamps, your percentage of revenue is exactly the same. The same is true of 4-C. P. Sterling Special Lamps for sign purposes.

AGAIN WE SAY

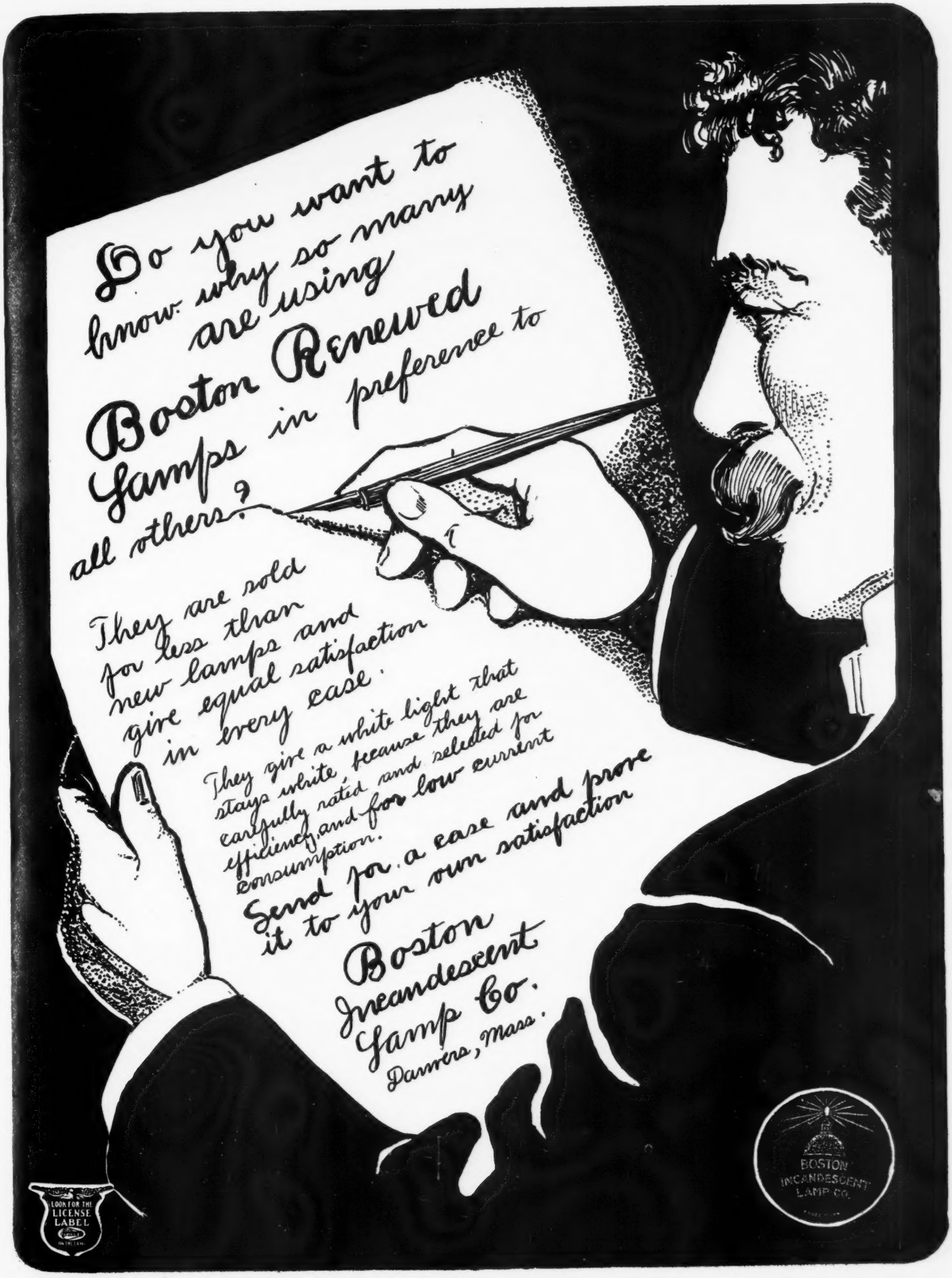
This is the first proposition of its kind ever offered to Central Stations, and you cannot afford to pass it by. Write us now for further particulars and prices before you forget it.

LOOK FOR THE LICENSE LABEL IN THE STEM

The Sterling Electrical Mfg. Co.

WARREN, OHIO

LOOK for the Sterling LABEL ON THE LAMP


Do you want to know why so many are using Boston Renewed Lamps in preference to all others?
They are sold for less than new lamps and give equal satisfaction in every case.
They give a white light that stays white, because they are carefully rated and selected for efficiency and for low current consumption.
Send for a case and prove it to your own satisfaction
Boston Incandescent Lamp Co.
Danvers, Mass.
LOOK FOR THE LICENSE LABEL
BOSTON INCANDESCENT LAMP CO.

Everything Points

We've told you about that big contract we secured in competition with every lamp company in the United States—**the LARGEST GEM LAMP INSTALLATION in the WORLD.** After four months of service not a lamp has been replaced. That points to the quality of *G. I. LAMPS.*

Now, Here's Another Point:

We make good Tantalum Lamps for either A.C. or D.C. 100-125-volt circuits, and to prove what we say we will replace your entire installation of ordinary carbon lamps with tantalum lamps. ¶ If, after thirty days' trial, you are satisfied with the improvement, we will bill the tantalums to you at the regular price, less your proper discount—less 15c. each allowance for every carbon lamp displaced by tantalum.

Now, for heaven's sake, can any one do more than this?

General Incandescent

Cleveland, Ohio

San Francisco Office

to G. I. Lamps

Once more we are paying for a whole page just to tell you, Mr. Consumer, who sells *G. I. LAMPS.* Note the reliable list! They all carry stocks. Prompt shipments---prices right, and backed up to the limit by the G. I. Co.

Any statements regarding G. I. Lamps made by our agents will be substantiated by us.

For prompt delivery write the nearest agent

M. B. AUSTIN & CO.
133-141 West Jackson Boulevard
Chicago, Ill.

HENDRIE & BOLTHOFF MFG. & SUPPLY CO.
1635 17th St., Denver, Colo.

COAST ELECTRIC CO.
312 San Pablo Ave.
Oakland, Cal.

HOBSON ELECTRIC CO.
172-174 Commerce St.
Dallas, Texas

CHRISTOPHER ELECTRIC CO.
Beaumont, Texas

W. F. IRISH ELECTRIC CO.
60 Cortlandt St., New York

ELECTRICAL EQUIPMENT CO.
Sandusky, Ohio

FRANK ADAM ELECTRIC CO.
904-914 Pine St.
St. Louis, Mo.

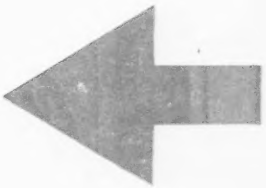
ROYSE ELECTRIC CO.
125 So. Meridian St.
Indianapolis, Ind.

SOUTHERN ELECTRIC CO.
423 N. Calvert St.
Baltimore, Md.

JACKSON & EARLE
Stockton, Cal.

MOUNTAIN STATE ELECTRIC CO.
911-913 Market St.
Wheeling, W. Va.

CROSBY, CRAFT & CO.
723 Williamson Bldg., Cleveland, O.



N.B.—Good Agents wanted in territory not covered
Send for latest circulars

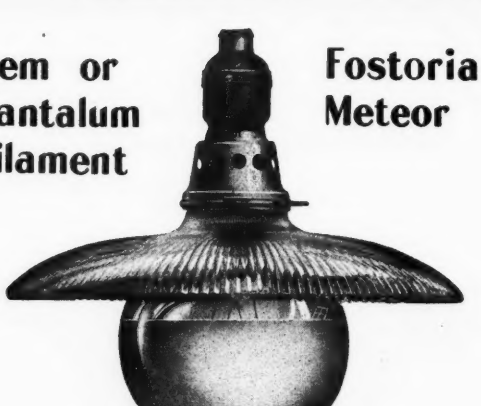
Lamp Company

1811 East 45th St.

104 Atlas Building

GET OUR BULLETINS

Gem or Tantalum Filament



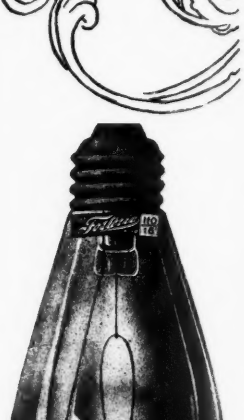
Fostoria Meteor

FOST

YES! Write us

Tungsten Lamps

The Famous Standard Fostoria



The Fostoria Incande

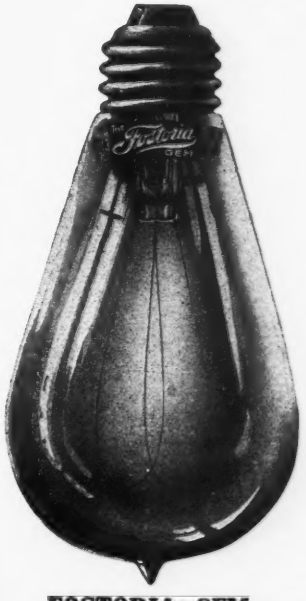
FOSTORIA, OHIO

Immediate Shipments

SOLA

FOSTORIA TANTALUM
Highest Commercial Efficiency Ever Attained

FOSTORIA GEM HIGH C. P.
The most economical, attractive and simple large interior lighting unit
All sizes
Write us for bulletin



FOSTORIA GEM LOW C. P.
If substituted for your 16 c. p. 3.5 watt lamps, this lamp will actually save you its total purchase price. Write us about it.

Agencies and Stocks in all Cities

scent Lamp Company

ST. PAUL, MINN. ATLANTA, GA. OAKLAND, CAL.

LOOK FOR THE LICENSE LABEL IN THE STEM

Brilliant

WATCH U

The Evolution of a

As our New Factory was April 1st
CONNEAUT, OHIO

As our New Factory was May 1st
CONNEAUT, OHIO

As our New Factory was June 1st
CONNEAUT, OHIO

As our New Factory was July 1st
CONNEAUT, OHIO

THE NEW BRILLIANT FACTORY

at Conneaut, Ohio, will be completed and ready for operation about September 15th. It took somewhat longer than we expected to finish, but we have spared no time, labor or expense to make it the most modern and up-to-date lamp factory in the world. Skilful experts spent days and weeks in planning the most ideal shop arrangement, and have been examining, choosing and buying the latest and best equipment for the manufacture of incandescent lamps, as it has been proven that the quality of a manufactured product is largely dependent on the factory behind it.

THE NEW BRILLIANT FACTORY

will embody the best features of every lamp factory ever constructed.

The high standard reached and constantly maintained in all types of BRILLIANT lamps has resulted in such a GREAT GROWTH in sales that the manufacturers have been forced to construct a plant several times greater in capacity than its old factory. Orders will be filled from the new works after September 15th for all types of incandescent lamps on the market, including all the new high-efficiency lamps. The old factory will continue in operation pending perfect organization in every department of the new plant.

THE QUALITY OF BRILLIANT LAMPS MERITS THE REPUTATION THEY BEAR.

LOOK FOR THE LICENSE LABEL

THE BRILLIANT
Cleveland,

S GROW

Brilliant

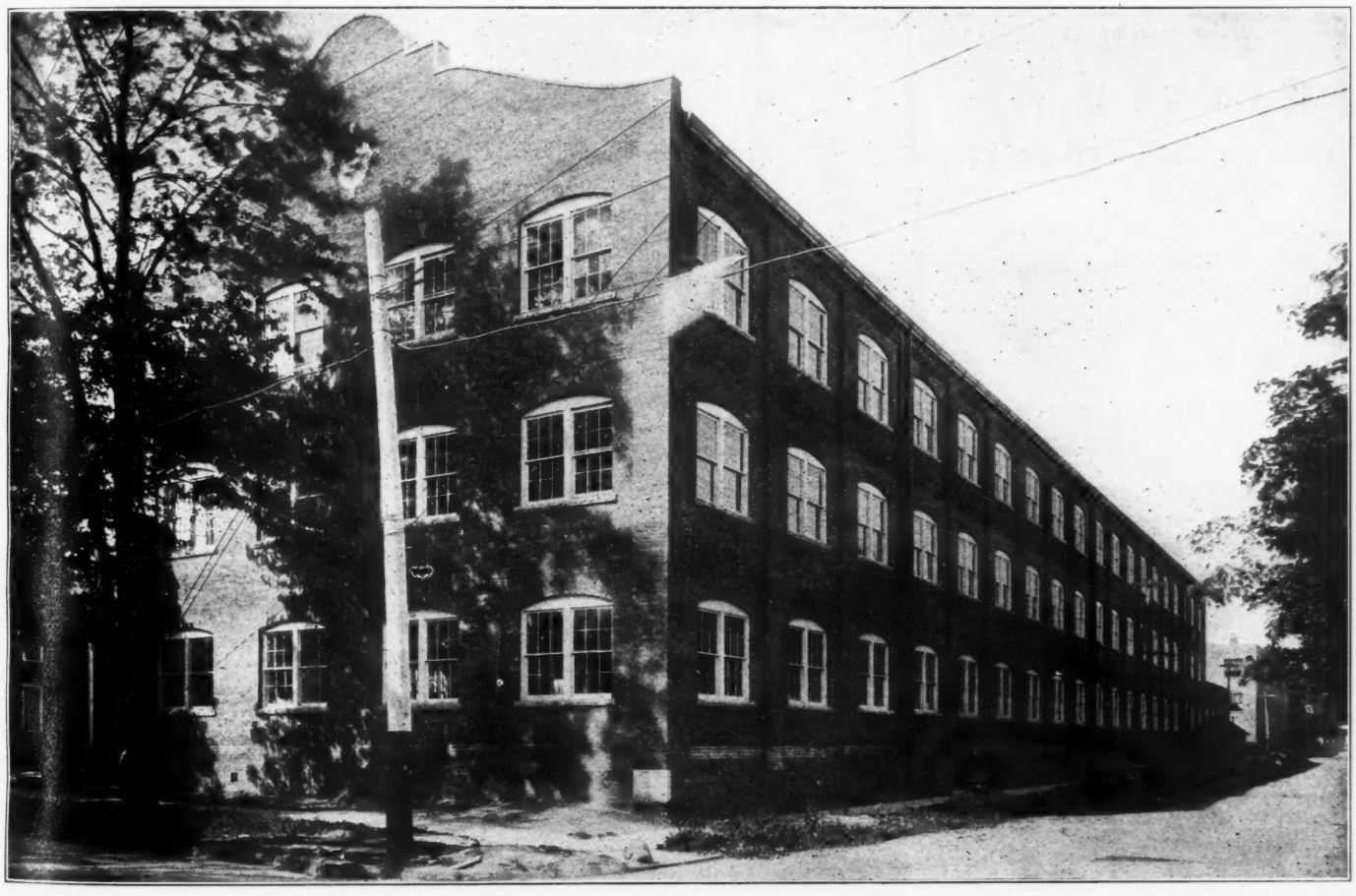
Great Lamp Factory

As our New Factory was August 1st
CONNEAUT, OHIO

THE LARGE NUMBER OF BRILLIANT LAMPS sold every year and the phenomenal increase in business tells the public verdict based on the evidence.

If you are a buyer or consumer of incandescent lamps and are not familiar with our product, we want you to know of the BRILLIANT lamps and our facilities.

Rush orders for any type of lamp on the market earnestly solicited. Write us.



As our New Factory Appeared September 1st, CONNEAUT, OHIO

ELECTRIC COMPANY
Ohio, U. S. A.

LOOK FOR THE LICENSE LABEL

THE LARGEST CENTRAL STATIONS

are now buying BANNER LAMPS in preference to all others.

DO YOU KNOW WHY?

REGULAR 110-VOLT

BANNER

STANDARD CARBON FILAMENT LAMPS

are sold at the rate of two million a year, and our business has increased in volume over 50 per cent during the year ending May 1st, 1907. THAT SPEAKS FOR QUALITY DOESN'T IT?

BANNER LAMPS

BANNER HIGH VOLT

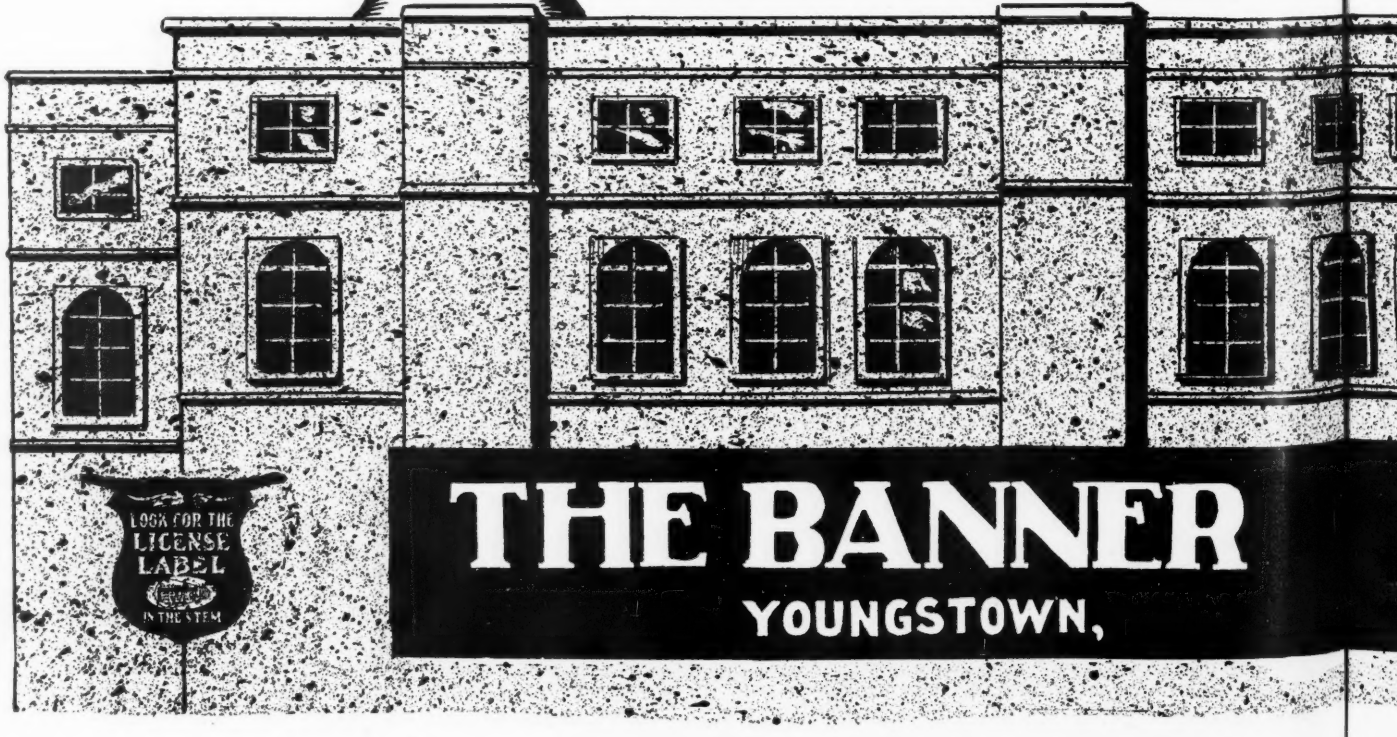
THE BANNER HIGH VOLTAGE LAMP

is the best of its kind, and we can prove it to your own satisfaction.

The filament is of our own special make, double anchored, and so adjusted that the possibility of short-circuiting is virtually eliminated.

ORDER FROM US

USED BY LIGHTING



THE BANNER

YOUNGSTOWN,

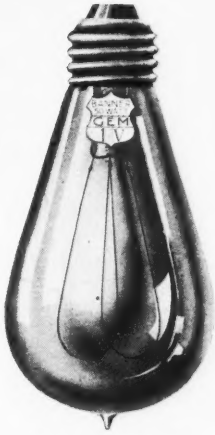
CENTRAL STATION QUALITY

TRY THE BANNER GEM FILAMENT

if you want the latest and most modern lamp.

It will SAVE YOU MONEY as it consumes less current and produces more light. The most up-to-date central stations are now using them

Described in Bulletins No. 3 and 4.



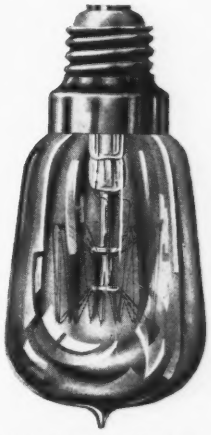
GEM 2½-WATT

THE LARGEST COMPANIES

IT'S "BANNER BETTERNESS"

that governs their choice.

They are unexcelled in quality and are fully GUARANTEED IN EVERY RESPECT.



TANTALUM 2-WATT

BANNER TANTALUM LAMPS

far exceed other lamps in efficiency of operation.

They consume but 2 watts per candle.

They are no longer an experiment but are a commercial success in every way.

Send for bulletin No. 5.

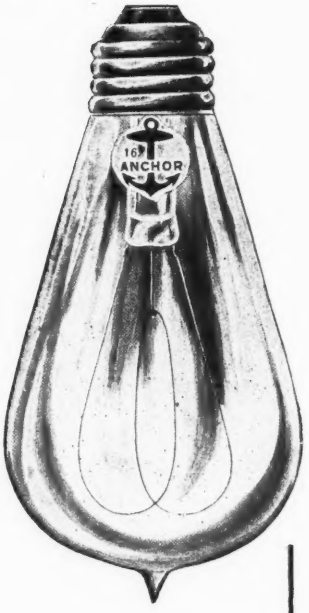
BANNER

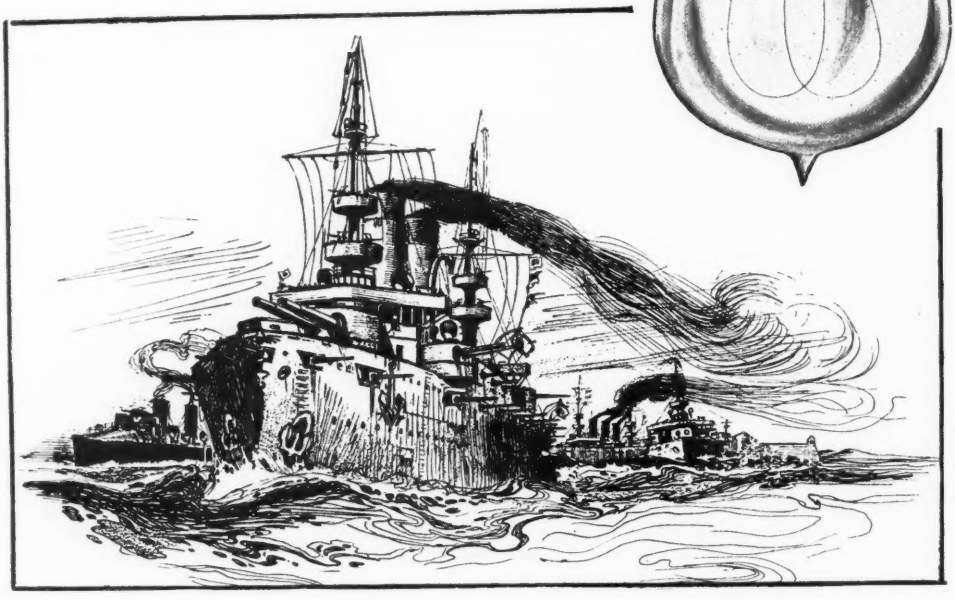
ELECTRIC CO.

OHIO.

GOOD ENOUGH
FOR THE
UNITED STATES NAVY

GOOD ENOUGH
FOR EVERYBODY





ANCHOR RENEWED LAMPS

EQUAL IN PERFORMANCE ANY CLASS A LAMP MADE—A TRIAL WILL PROVE IT. 50% MORE LAMPS FOR THE SAME MONEY YOU PAY FOR OTHER LAMPS OF EQUAL QUALITY, SHOULD BE WORTHY OF YOUR CONSIDERATION.

ANCHOR LAMP COMPANY
258 BROADWAY NEW YORK

LOOK FOR THE LICENSE LABEL

Packard

LOOK OUT FOR THE PACKARD LABEL WHEN ORDERING LAMPS.

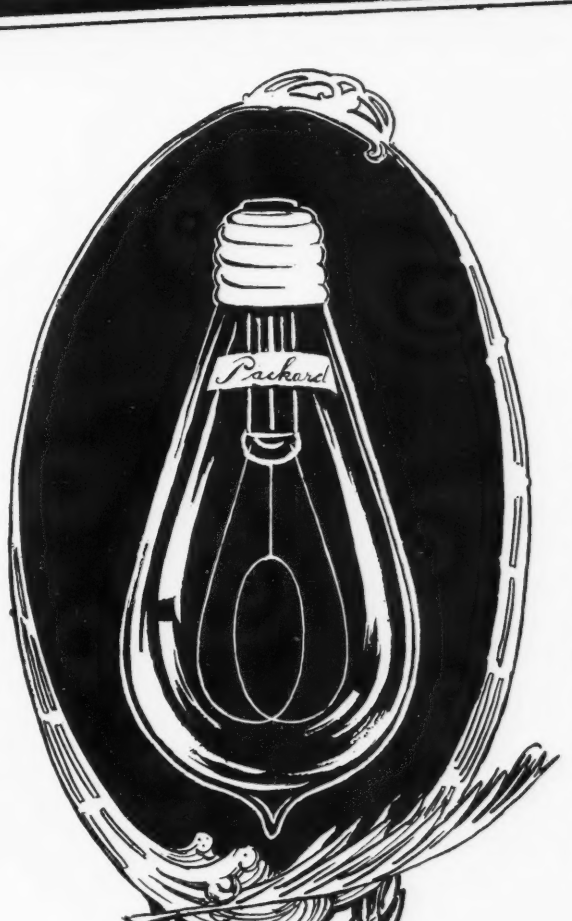
We make all types of incandescent lamps.
Regular Packard Lamps Class A
Warren Lamps Class B
Gem Zenith,
Gem High-Candle-Power,
Tantalum, Miniature, Special Street Series, etc.

Manufactured by

NEW YORK & OHIO CO.

401 North Avenue

WARREN OHIO



SOLD BY

ELECTRIC APPLIANCE COMPANY,
Chicago, Dallas, San Francisco, New Orleans

THE B-R ELECTRIC & TELEPHONE MFG. CO.
Kansas City, Mo.

SIBLEY & PITMAN,
New York City

THE CLEVELAND ELECTRICAL SUPPLY COMPANY,
Cleveland, Ohio

H. I. SACKETT ELECTRIC COMPANY,
Buffalo, N. Y.

CHARLESTON ELECTRICAL SUPPLY COMPANY,
Charleston, W. Va.

BRAID ELECTRIC COMPANY,
Nashville, Tenn.

ELECTRIC SERVICE SUPPLIES COMPANY,
Philadelphia, Pa.

BOWIE & LOVE,
Tacoma, Washington

ROBERT B. EDES,
302 Oliver Building, Boston

STEEL CITY ELECTRIC COMPANY,
Brown-Marx Building,
Birmingham, Ala.

Lamps

THE STANDARD ELE

THE HANDWRITING

The handwriting on the wall has been seen by many of the larger Central Stations. Realizing the necessity of supplying their customers with new high efficiency lamps rather than wait until the customer makes such purchase.—Complete installations have been made—free renewal system or at equitable price. News travels fast—the man of average acumen will soon be buying high efficiency lamps in the open market if not supplied otherwise. He will certainly discontinue the use of 56 watt lamps, 16 c. p., when he can buy a lamp of one to two watts per candle-power economy. ¶Under existing conditions, it will certainly pay you to create the initiative, install the most efficient lamp obtainable, change your rates accordingly, and promote harmony in general. You will not only reduce your load, but with the marked improvement of service, will secure enough additional business to more than pay for the change.

STANLEY & MUENCH
50 Prospect Place
BROOKLYN

L. P. CLARK & CO.
510 Arch Street
PHILADELPHIA

J. G. SCHAFF
HAGERSTOWN

THE
THAT'S

WRITE FOR

NILES, O.

CTRICAL MFG. CO.

ON THE WALL

This change is inevitable anyway, and is a matter of such vital importance that delay will mean your ultimate loss. The adjustment of your system to the new conditions is most opportune and will hasten the date when your dividends will increase. ¶We manufacture every type of lamp, from carbon to Tungsten. We have exceptional factory facilities and you will find our product represents the best value on the market. Star lamps have stood the test of time, and the reputation of our Company is back of every order we ship. ¶If convenient and you desire to "talk it over," we will have our representative call. We would advise immediate action, as your best interests will be served in writing us on this subject to-day.

THE STANDARD ELECTRICAL MFG. CO.

F. M. ODENA, Jr.
1116 Chamber of Commerce
DETROIT

BULLOCK-WAIT CO.
86 Lake Street
CHICAGO

JOHN C. USSHER
317 Park Bldg.
PITTSBURG

JOS. THIEBEN & CO.
585 Mission St.
SAN FRANCISCO

UNITED ELECTRIC CO.
WICHITA

LIGHT
RIGHT

EXCLUSIVE AGENCY

U.S.A.

COLONIAL LAMPS ARE THE BEST

THE COLONIAL ELEC. CO.

Warren, Ohio

New York: 136 Liberty Street

COLONIAL STANDARD LAMPS

Are the best that modern science can produce.

There isn't a detail about Colonial Lamps that could be improved upon.

Central Stations that choose Colonial Lamps, choose wisely.

For all-around excellence and reliability they stand in a class by themselves.

Unsurpassed in candle hours, close selection and correctness of rating.

LET US QUOTE YOU PRICES ON YEARLY CONTRACTS

COLONIAL TANTALUM

THE HIGHEST EFFICIENCY OF ANY FORM OF INCANDESCENT LAMP REQUIRING ONLY 2 WATTS PER C.-P.

MAXIMUM BRILLIANCY OF LIGHT
MAXIMUM EFFICIENCY

The Colonial Tantalum takes but one-half the current of the ordinary Incandescent Lamp of similar voltage and candle-power.

With the same current, it gives twice as much light as an ordinary Incandescent Lamp.

Voltages—from 100 to 130—frosted or clear globes, average life 700 hours.

LARGE STOCK READY FOR DELIVERY

COLONIAL GEM

HIGH EFFICIENCY LAMPS

For even light distribution, and steady, soft, white light, they cannot be excelled.

They produce a light that is nearer to day-light than any other form of lamp on the market.

State voltage and wattage of lamp desired when ordering.

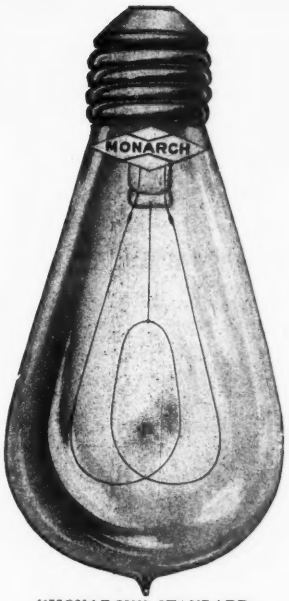
We keep a large supply of every known type of incandescent lamp ready for immediate delivery.

SEND US A RUSH ORDER

MONARCH LAMPS

ARE WORTH INVESTIGATING

BECAUSE they represent the latest and best in incandescent lamps. The largest and most careful buyers are now specifying them in preference to all others.



"MONARCH" STANDARD

ARE WORTH BUYING

BECAUSE you'll never be disappointed, as they are backed by years of lamp-making experience. You can always rely upon the quality.

"MONARCH" SPECIAL

Can be furnished with either Gem or Carbon filament.

ARE WORTH USING

BECAUSE they give the brightest light and have the longest life. They not only give maximum, but also uniform illumination. Our stock of standard lamps as well as special lamps is large enough to handle the largest order in the shortest possible time. Write us for quotations on your yearly requirements.

We are in a position to furnish both Tantalum Lamps and Gem High-Efficiency Units

THE MONARCH ELECTRIC MFG. CO.

LOOK FOR THE LICENSE LABEL

WARREN, OHIO.

LOOK FOR THE LICENSE LABEL

THINK SERIOUSLY

WHEN YOU THINK OF
INCANDESCENT LAMPS,
THINK OF THE

PEERLESS

THE LAMP OF QUALITY

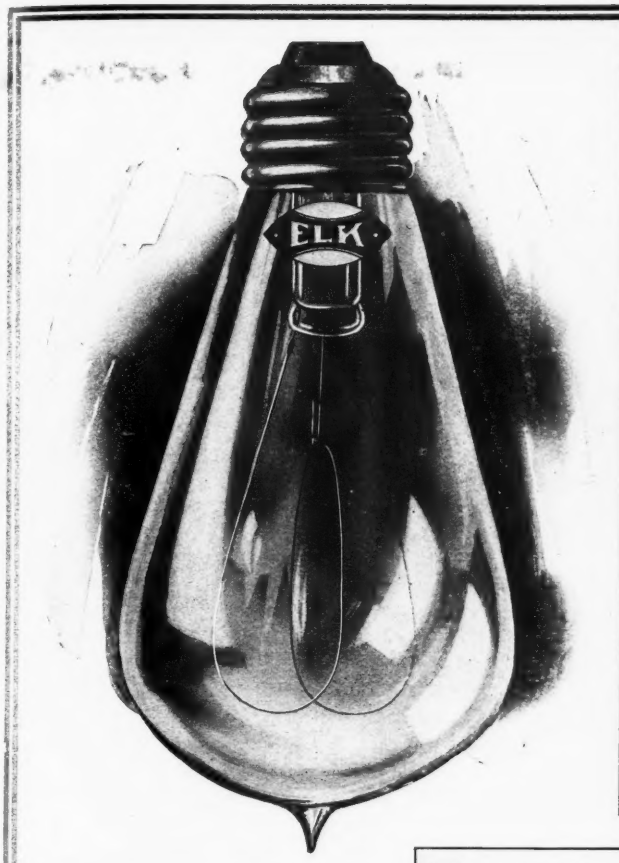
THE LAMPS ARE RIGHT—

THE PRICE IS RIGHT
DELIVERIES WILL PLEASE YOU
A TRIAL WILL CONVINCE YOU

SEND US YOUR ORDER NOW

THE WARREN
ELECTRIC AND SPECIALTY CO.

WARREN, OHIO, U. S. A.



"ELK" New Lamps

Represent the best that modern skill can produce. For all-around satisfaction they can not be equaled, which is evidenced by the fact that the most exacting buyers all over the country are now using them.

¶ Write for our prices on yearly contracts.

"EXCELL" Renewed Lamps

Will save you money on your yearly lamp bills. They are guaranteed in every respect. They are renewed with the utmost care and subject to the most rigid tests.

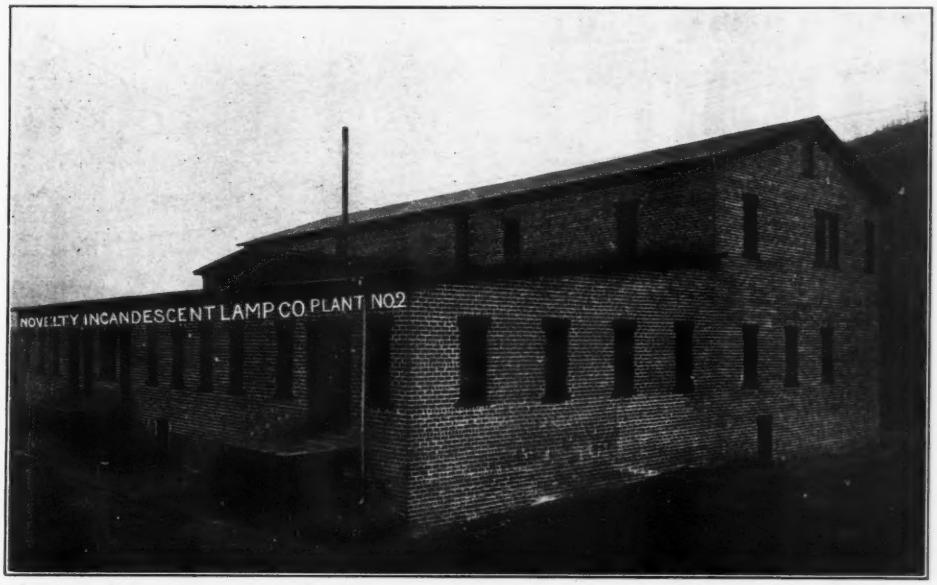
¶ No depreciation in the value of light.

¶ Write for our renewed lamp proposition.

ELK
Factory
EMPORIUM, PENN.

TRADE MARKS OF QUALITY

CP X L V
Factory
ST. MARYS, PENN.



OUR NEW FACTORY AT EMPORIUM, PA. FOR THE MANUFACTURE OF "ELK" LAMPS

Factory No. 1 at St. Marys, Pa. is used exclusively for the manufacture of renewed lamps

Increased Facilities enable us to supply you with the lamps of quality in any desired quantity, shipped immediately upon receipt of order if desired. :: ::

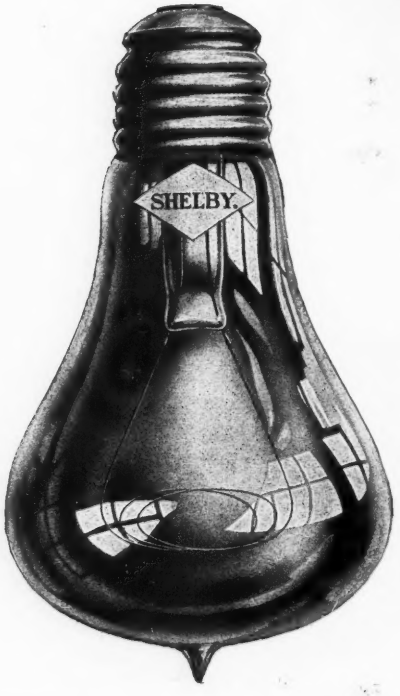
NOVELTY INCANDESCENT LAMP CO.

Main Office: EMPORIUM, PA. Plants: "Elk," Emporium, Pa.; "XL," St. Marys, Pa.

THE ONLY INDEPENDENT PENNSYLVANIA LAMP COMPANY

SHELBY

SHELBY USEFUL LIGHT



45 WATT LAMP

SOLVES THE QUESTION of the proper distribution of light. The kind of Lamps you have been using, although rated 16 C. P., deliver 7 C. P. in the direction opposite the base and they require 50, 56 or 64 watts. SHELBY USEFUL LIGHT LAMPS DELIVER MORE LIGHT OPPOSITE THE BASE THAN ANY OTHER LAMP AND CONSUME BUT 45 WATTS. This has been proven by recent tests. They will last as long as any 16 C. P. 56 watt Lamp made. THE SHELBY LAMP IS BASED ON THE MOST MODERN PRINCIPLES OF ILLUMINATION.

Send for Booklet "The Cost of Illumination"

LOOK FOR THE LICENSE LABEL IN THE STEM

THE SHELBY

Nos. 6 to 30 HIGH ST.

BRANCHES: Boston New York Philadelphia Chicago Baltimore Pittsburg Cleveland Cincinnati Detroit

SHELBY TANTALUM

High Efficiency Lamp

Consumes less current and costs less than any other form of lighting device of similar size and illuminating value

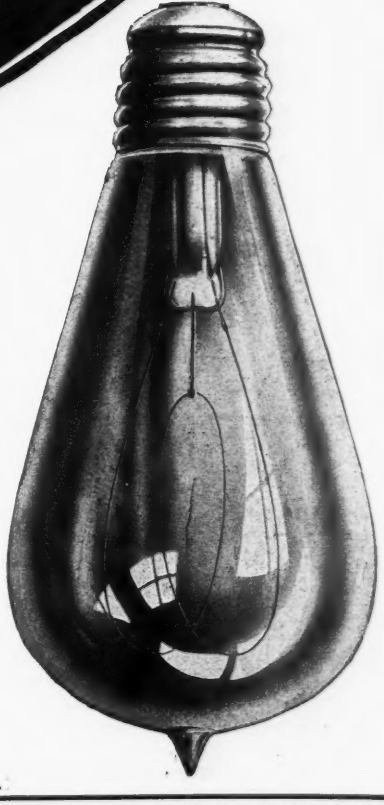
FACTS

EFFICIENCY—2 Watts per Horizontal C. P.
CANDLE-POWER—22 C. P. Horizontal
AVERAGE LIFE—700 hours on direct current
VOLTAGES—100 to 130 or, in series, 200 to 250, clear or frosted globes. Can be used with or without reflectors

LAMPS

SHELBY OVAL FILAMENT LAMP

Just as good if not better than any Lamp of its kind made. It is the leader in all qualifications that go to make the best that is obtainable in this type. If you prefer this type of Lamp you will be sure of getting honestly rated, closely selected Lamps that represent the best that modern science and skill can produce.



ELECTRIC CO.

SHELBY, OHIO, U. S. A.

Louisville St. Louis San Francisco Indianapolis Portland Atlanta Washington, D. C.

A Boon To Your

WRITE FOR OUR SPECIAL TANTA-

The Tantalum Lamp has been laboring under a disadvantage. It wasn't satisfactory on A. C. Circuits.

That's Ancient History.

Buckeye Tantalum Lamps for Alternating Current Circuits

give perfect service on 25 or 60 cycles as well as on **D. C.**

It's simply another proof that we're alive to the fact that our interests are identical with those of our customers.

BUCKEYE GEM, METALLIZED AND HIGH C. P. UNITS AND THE OLD RELIABLE BUCKEYE CARBON FILAMENT LAMPS ALL DESERVE YOUR CHOICE.

THE BUCKEYE ELECTRIC COMPANY

CHICAGO: 23 East Lake Street **PITTSBURG: 611 Empire Building**

Frank H. Stewart Electric Co , Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
The Post-Glover Electric Co., Cincinnati, Ohio
Dunham, Carrigan & Hayden Co., San Francisco, Cal.
Henry L. Walker Co., Detroit, Mich.
Nebraska Electric Co., Omaha, Neb.
Union Electric Co , Pittsburg, Pa.
Piedmont Electric Co , Anderson, S. C.
B. & C Electrical Construction Co , Utica, N. Y.
Hide, Leather & Belting Co., Indianapolis, Ind.
W. C. Teas, Chattanooga, Tenn.
The Western Gas Fixture Co., Toledo, Ohio
The Erner & Hopkins Co., Columbus, Ohio
The Royse Electric Co., Indianapolis, Ind.

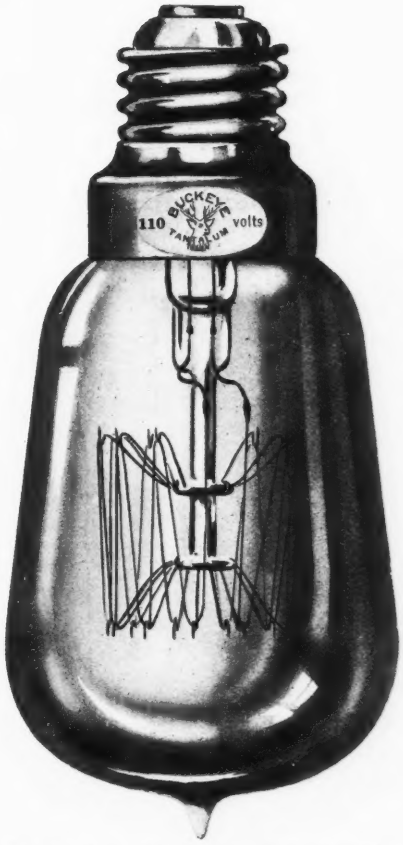
New Business Dept.

UM REPLACEMENT PROPOSITION

The only incandescent lamp giving a pure white light.

The newest and best

Worthy of consideration before your heavy fall business comes on.



Regular No. 1 Tantalum, 20 c. p., 40 watts

Write for information about these lamps.

Reg. No. 2 Tantalum
40 c. p. 80 watts

No. 1 Tantalum
Meridian

No. 2 Tantalum
Meridian

Write for new prices and discounts.
No contracts required.

WILL FIT ALL MERIDIAN FIXTURES

MAIN OFFICE AND WORKS: CLEVELAND, OHIO

DALLAS, TEX.: Linz Building

NEW YORK: 114 Liberty Street

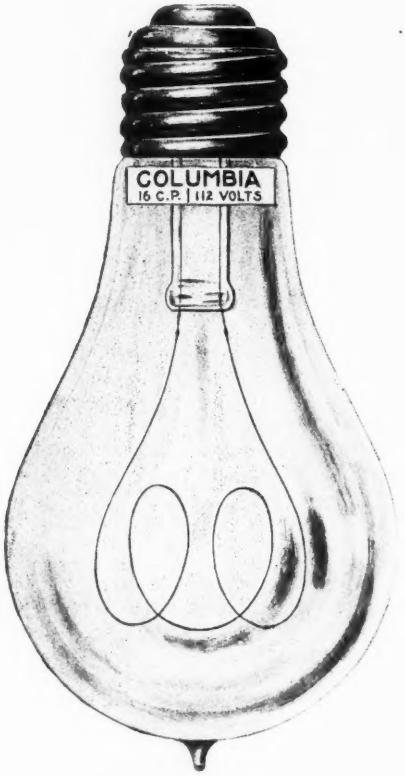
LOOK FOR THE LICENSE LABEL

Kokomo Electric Construction Co., Kokomo, Ind.
Machine Electric Supply Co., Muncie, Ind.
Louisville Electric Supply Co , Louisville, Ky.
Geo. J. Lambrecht, Hannibal, Mo.
Butterworth & Reiter, Dayton, Ohio
O. J. Goettmann, Allegheny, Pa.
Dauphin Electrical Supplies Co., Harrisburg, Pa.
Springer & Patterson, Pittsburg, Pa.
Carter Electric Co., Pittsburg, Pa.
Shepherd-Fluharty Electric Co., Baltimore, Md.
Westbrook Bros. & Co., Greensboro, N. C.
American Machine & Man'f'g Co., Charlotte, N. C.
Chas. E. Sharp, Security Building, St. Louis, Mo.
Special Agent Republic of Mexico

COLU LAM

COLUMBIA LAMPS will stand the most critical comparison with any lamp on the market.

MOST LIGHT



Buy Quality

Pay Dividends

There is more than one reason for the superiority of COLUMBIA LAMPS.

If not at present using COLUMBIA LAMPS place a trial order for a standard package or larger quantity subject to our guarantees of uniformity, efficiency and candle-power maintenance.

Poor Lamps Eat Your Profit

COLUMBIA LAMPS have passed the stage of experiment.

The unvarying sustained quality alone accounts for our 18 years of uninterrupted success.

The Columbia Incan-

LOOK FOR THE LICENSE LABEL

Main Office and Factory, 2115-17-19

BRANCH OFFICES:

New York, Taylor Building, 39-41 Cortlandt Street **Dallas, 409 Main Street**
Philadelphia, 1221 Real Estate Trust Building

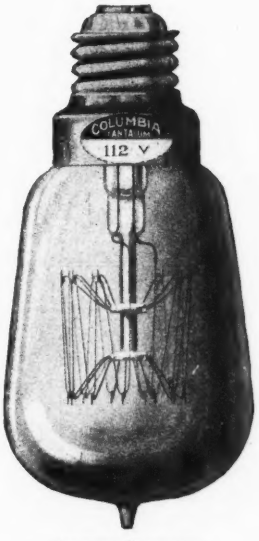
MBIA

P S.

LEAST COST

We can furnish every type of lamp that has been made a commercial success.

GEM METALLIZED HIGH C. P.

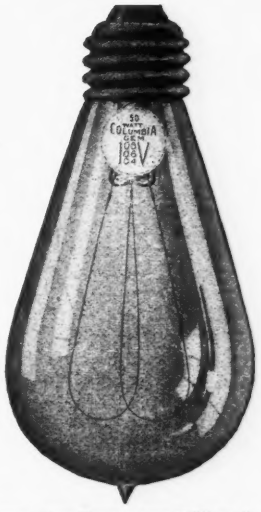


COLUMBIA TANTALUM
100 TO 130 VOLTS, 22 C. P., 44 WATTS

Our unsurpassed facilities enable us to turn out perfect lamps

All the Time
AND
Every Time

It will pay you to look us up before making your next contract.



COLUMBIA GEM METALLIZED 50-WATT LAMP
100 TO 130 VOLTS, 20 C. P. AT 2.5 W. P. C.

descent Lamp Co.

Locust Street, SAINT LOUIS, MO.

BRANCH OFFICES:

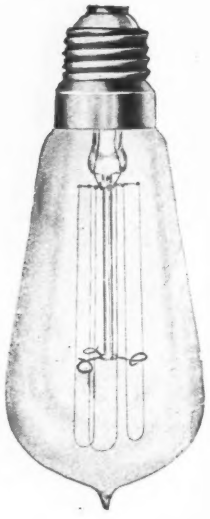
Chicago, 264-270 Fifth Avenue Memphis, 26 Randolph Building
Mexico, Monterey—Sanford & Cia

LOOK FOR THE LICENSE LABEL

THE "JUST" TUNGSTEN LAMP

A GREAT SUCCESS

PATENTS GRANTED AND PENDING IN ALL COUNTRIES



1 WATT PER HEFNER CANDLE

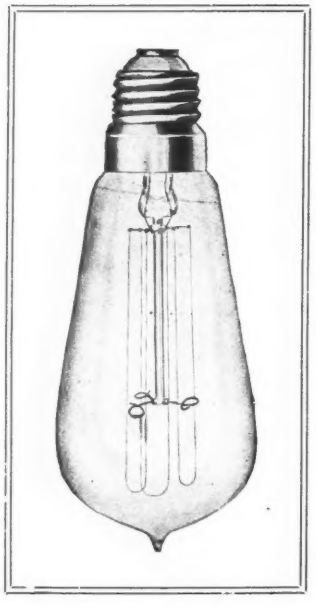
¶ 70 per cent. saving over 3½ watt carbon filament lamps. ¶ Burn on direct or alternating current. ¶ Average life 1,000 hours, with practically no decrease of c. p. ¶ Thousands of satisfied customers all over the country. ¶ Prompt shipment from stock. ¶ Shipped safely any distance. ¶ If you want them you must order now for immediate or Fall delivery.

The Electrical Accessaries Company

Sole distributers for the American Continent

1135 BROADWAY :: :: :: NEW YORK

THE TUNGSTEN LAMP



1 WATT PER CANDLE

We are carrying Tungsten lamps in Chicago stock in 40 C. P. and 110 volts and are prepared to make actual delivery immediately upon receipt of your order.

The Tungsten lamp effects a saving of 70 per cent on the light bill over the ordinary carbon filament lamp, and the average life of the lamp is 1000 hours, with no apparent decrease in candle power throughout its entire life. The lamp gives a most agreeable white light, the quality of the light being far superior to that of the present carbon filament lamp.

Lamps shipped absolutely at owner's risk. Write for prices.

Central Electric Company,

General Western Agents

264 - 266 - 268 - 270 Fifth Avenue, CHICAGO

BRYAN-MARSH CO.

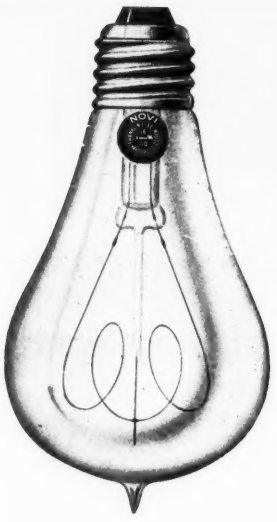
WE SUPPLY THE MOST CRITICAL USERS

Incandescent Lamps

NEW YORK CHICAGO OAKLAND

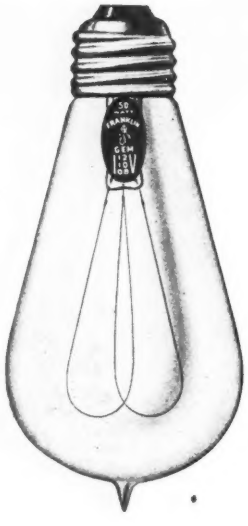
2

Factories Insure Immediate Delivery of



Franklin Tantalum

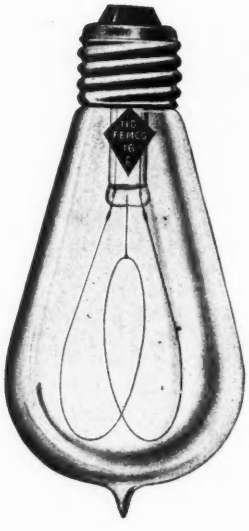
Franklin Gem



Femco Standard
(Carbon Filament)

Novi Type
(Carbon Filament)

Incandescent Lamps



Bulletins No. 11, 12, 13, 14 and 15 Mailed Upon Request

The Franklin Electric Mfg. Company

General Office: HARTFORD, CONN.

Factories: HARTFORD and MIDDLETOWN, CONN.

Branch Offices and Stock Rooms

NEW YORK
26 Cortlandt Street

CHICAGO
602 Fisher Bldg.

BUFFALO
121 Franklin Street

BALTIMORE
2011 E. North Avenue

ST. LOUIS
1414 Chestnut Street

PHILADELPHIA
1022 Arch Street

Pacific Coast Representatives

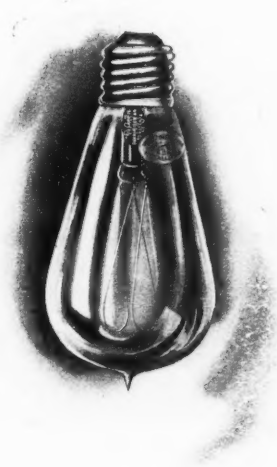
SAN FRANCISCO
Holabird-Reynolds and Sayles Co.

LOS ANGELES
Holabird-Reynolds Electric Co.

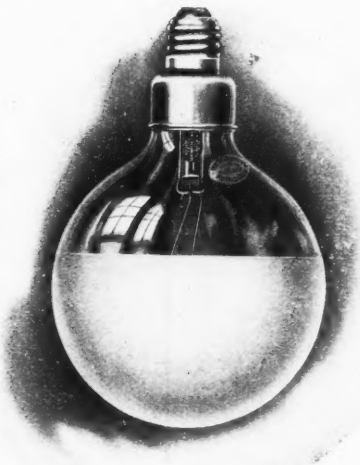
Westinghouse

High Efficiency Metallized Filament Lamps

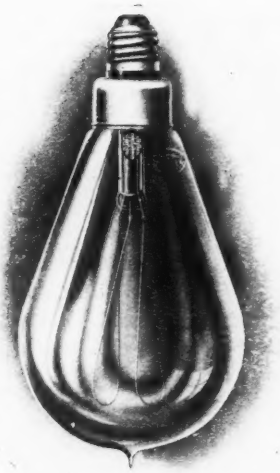
2½ Watts per Candle



50 Watt Type



Meridian Type



High Candle Power Type

THE NAME IS YOUR GUARANTEE

WESTINGHOUSE LAMP CO.

510 to 534 WEST 23d STREET,
NEW YORK

Product sold by

Westinghouse Electric and Manufacturing Company

Sales Offices:

Atlanta, Baltimore, Birmingham, Boston, Bluefield, W. Va., Buffalo, Butte, Charleston, W. Va., Charlotte, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Denver, Detroit, Hazleton, Pa., Joplin, Kansas City, Los Angeles, Louisville, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburg, Richmond, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse, Tucson

Factories:

512-534 West 23d Street, New York, N. Y.
and Bloomfield (Watsessing), New Jersey

OVERHEARD IN A CENTRAL STATION

"HOLD ON, DON'T GET TOO EXCITED"

"THANKS FOR YOUR INFORMATION. GOOD DAY, SIR"
"GOOD DAY"

CUSTOMER—"Are you the manager of this plant?"

MANAGER—"Yes, sir. What can I do for you?"

CUSTOMER—"Well, I just came in to tell you that if you don't correct my last month's bill for light, I'm going to take the d—— meter and throw it out. It looks suspicious to me, and I don't think the record is right at all. My bill last month was heavier than it ever has been, and I'm not going to pay it. That settles it! It looks to me as if you had a meter that worked particularly fast for your own benefit."

MANAGER—"Hold on, don't get too excited. The meter's all right and your bill is right to a penny. I'll prove it to you before we're through. There couldn't be anything the matter with the meter, because it's a DUNCAN. You can't beat it, nor we can't beat you. In all my experience as an electrical engineer, I have never heard of a faulty one among the thousands in use."

CUSTOMER—"Well, I hope you will pardon me for being so abrupt in my language, but now as I learn the meter I have is a DUNCAN, I can not account for the enormous bill last month, except that we've been working our factory overtime, or careless help have kept our machinery running when not in use, or the night watchman has needlessly let the lights burn all night. However, I am the one to apologize, as I know that the DUNCAN holds the highest record for accuracy, simplicity and longevity. I will hereafter accept its face value at par, and as long as I pay my bills as recorded by the DUNCAN, my conscience will be clear and I will be perfectly contented and happy. I want to compliment you on your good judgment in using nothing but the best meter. Thanks for your information. Good day, sir."—"Good Day."

N. B.—We especially invite all central station managers who have had similar experiences with grouchy patrons wrangling about bills, etc., to give your customers a severe treatment of DUNCAN METERS.

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, INDIANA, U. S. A.

LOOK AT THESE CURRENT COSTS

STUDY THEM CAREFULLY IT WILL PROVE A SAVING OF **70** PER CT. ON YOUR CURRENT BILLS

For Burning Lamps for 1,000 Hours

LAMP	Kw. Hrs.	COST PER KW. HOUR 2c.	5c.	10c.	15c.
25-C.P. SIRIUS	25	$ .50	$1.25	$2.50	$ 3.75
25-C.P. Carbon	87½	1.75	4.38	8.75	13.12
16-C.P. Carbon	56	1.12	2.80	5.60	8.40
20-C.P. G. E. M.	50	1.00	2.50	5.00	7.50
20-C.P. Tantalum	41	.82	2.05	4 10	6.15

Did You Notice the Candle Powers?

SAFE DELIVERY GUARANTEED

RESULTS ARE PRODUCED BY THE

SIRIUS COLLOID LAMP

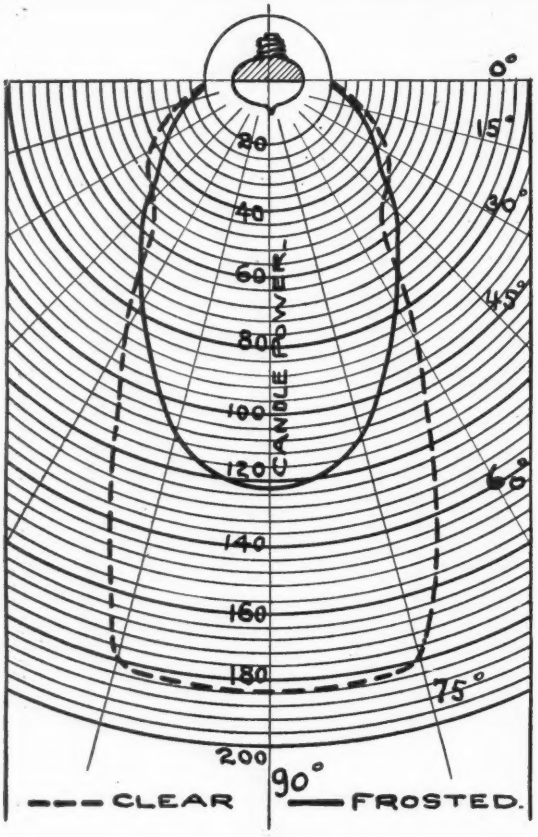
It gives better light, lasts longer and cos's less to operate than any other lamp on the market.
This lamp is no longer an experiment, but it has more practical commercial value than any other lamp made.

SAFE DELIVERIES GUARANTEED

THE EFANDEM COMPANY

201 EAST SIXTEENTH STREET, NEW YORK

GERMANIA Reflector Lamps



THE ONLY SUCCESSFUL AND PRACTICAL REFLECTOR LAMPS ON THE MARKET—concentrate the light in useful directions. Highest end-on candle power for current consumption of any lamp on the market.

SEE THE DIAGRAM

The metallic backing will not crack or peel off. Our new process of silvering the globe gives a far more perfect reflecting surface than ever before attained.

BY USING GERMANIA REFLECTOR LAMPS you need fewer lamps and can SAVE on both YOUR LAMP and CURRENT BILLS.

THE ONLY REAL ILLUMINANTS ON THE MARKET. Furnished either clear or frosted at the same price.

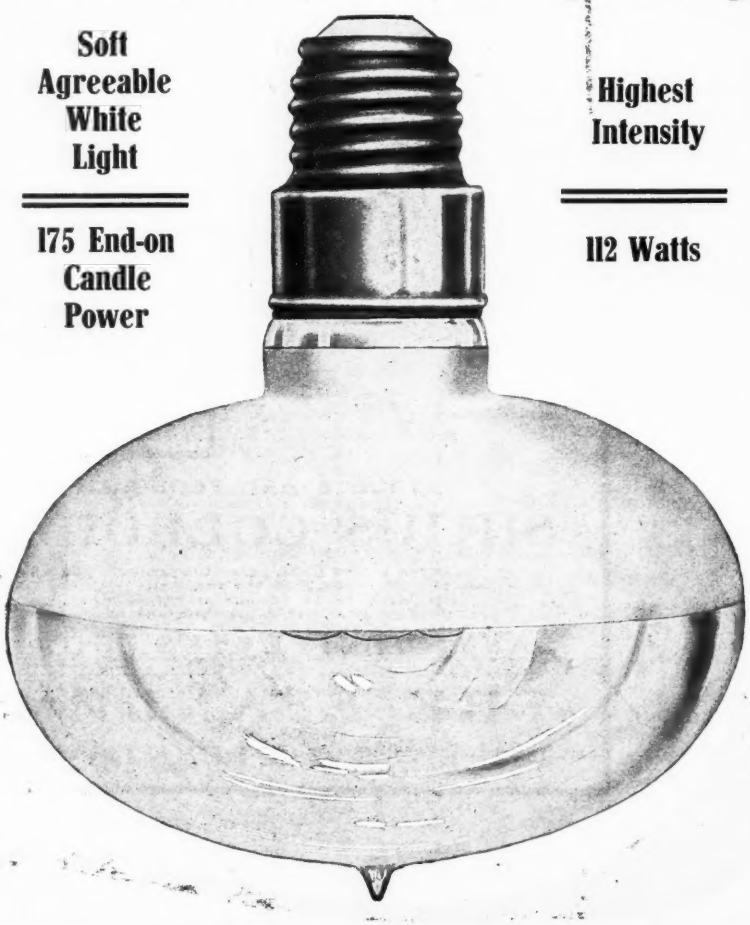
Write for our INDEPENDENT prices. Always state voltage when ordering.

Soft Agreeable White Light

175 End-on Candle Power

Highest Intensity

112 Watts



Germania Reflector Lamps

Are made in four sizes, corresponding in current consumption to 4, 8, 16 and 32 c. p. regular lamps, but giving respectively 20, 35, 75 and 175 downward c. p., hence requiring less than one watt per candle of useful light.

The smaller sizes are especially adapted to take the place of ordinary 16 c. p. lamps, giving greater useful light on a much smaller current consumption. The larger lamps are for use where a greater intensity of illumination is desired.

We also manufacture regular oval filament lamps. All voltages, all candle powers.

Write for our NEW price list.

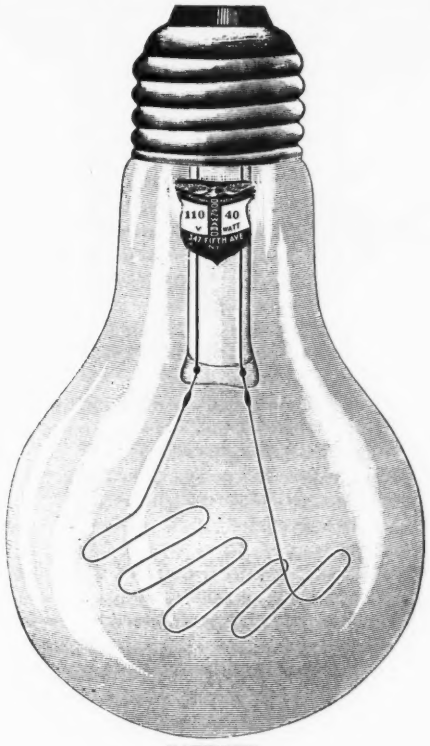
Germania Elec. Lamp Co.

120 Liberty Street - - NEW YORK

420-422 Ogden Street - NEWARK, N. J.

AGENTS WANTED EVERYWHERE

TIP OR TIPLESS



PATENTED

20 Per Cent Less Current

145 Per Cent Longer Life

71 Per Cent More Downward LIGHT

LIGHT

VS.

ILLUMINATION

The principle of illumination is to help us see things well. A room is well illuminated when the light is directed on the objects you wish to see. Proper illumination depends upon the *quantity* and the *right use of light*. The ordinary lamp, dating back to the original incandescent lamp, was made simply to give light---not to illuminate, and as long as it was labeled 16 c. p., people were satisfied. Why should you pay for more current than you need to produce a given illumination?

Use The

TRADE

DOWNWARD LIGHT LAMP

MARK

And You Pay for Light Actually Used—ILLUMINATION

OUR NEW 40-WATT LAMP is the only lamp made that gives its maximum and full-rated c. p. downward. Recent tests by the Government show that the downward light lamp gives 128 *per cent more light downward* than the ordinary type of filament.

SPECIAL INDUCEMENT

We will supply a sample case (300 lamps) for demonstration, allowing 30 days' trial, and if not as represented, you are privileged to tear up the bill and return the lamps at our expense.---Try them.

AGENTS WANTED

DOWNWARD LIGHT ELECTRIC CO.

347 Fifth Avenue - - NEW YORK

LOOK FOR THE LICENSE LABEL

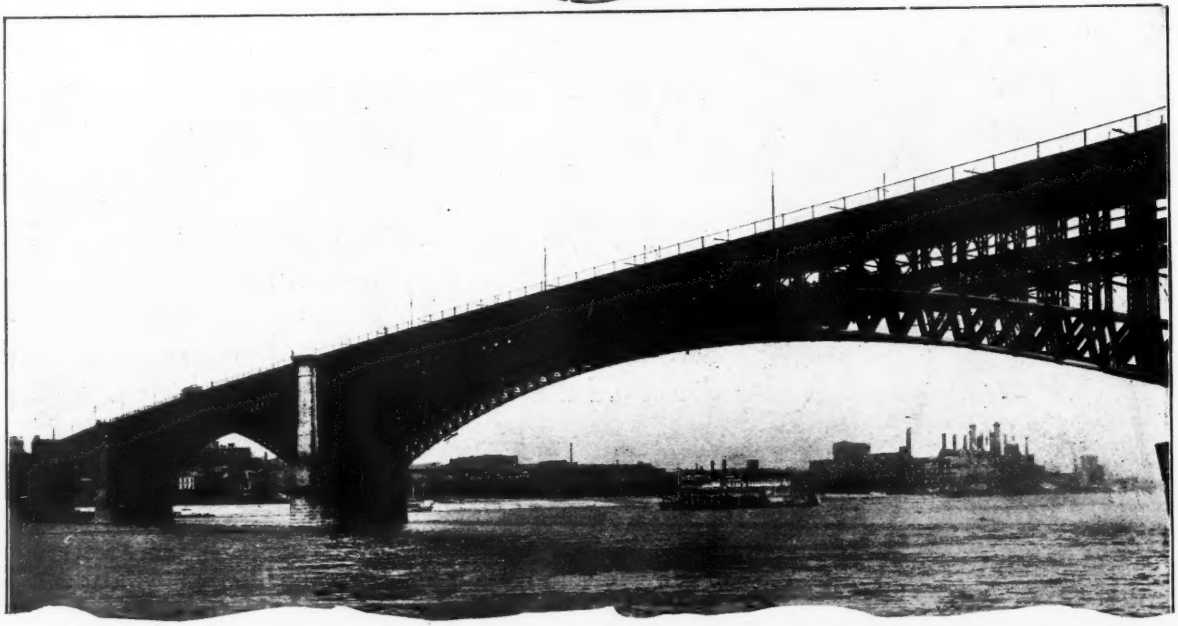
Fort Wayne Electric Works

"WOOD" SYSTEMS

This Lamp on This Bridge

Is a Fort Wayne Form C Arc Lamp. It is neat, rigid, reliable, and gives the right light at the right time.

Form C Lamps are made in several types. We have a lamp for every service. We have one for yours.



Any time of the night you will find the FORT WAYNE ARC LAMPS faithfully performing their duty on

The Eads Bridge, St. Louis

You know that's in Missouri. They said "Show Us," so we did. There's a reason why those Lamps are still there—showing those Missourians—RELIABILITY, that's why.

They represent the Fort Wayne Series A. C. Lighting System described in Bulletin 1090. Write for it.

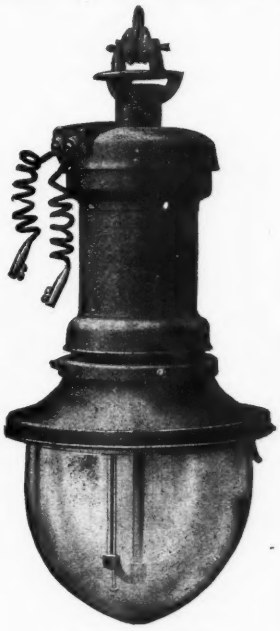
SALES OFFICES
ATLANTA CINCINNATI BOSTON
GRAND RAPIDS CHICAGO
NEW ORLEANS NEW YORK

MAIN OFFICE
Fort Wayne, Indiana

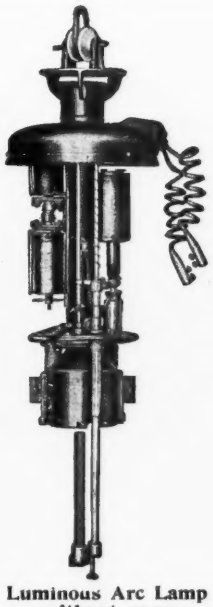
SALES OFFICES
PHILADELPHIA ST. LOUIS PITTSBURG
ST. PAUL SAN FRANCISCO
SYRACUSE YOKOHAMA

580

General Electric Company



Luminous Arc Lamp



Luminous Arc Lamp without case

Series Luminous Arc Rectifier System for Street Illumination

The luminous arc surpasses the enclosed arc as the enclosed arc excelled the open carbon arc for street illumination. All the light comes directly from the long luminous arc, resulting in an abundance of effective illumination. The light is white, steady, and produces no shadows from interference of electrodes.

Advantages of this system

Better service
Higher efficiency
Greater illumination
No moving machinery
Adapted to any frequency
Improved distribution of light

The rectifier, supplied with alternating current through a constant current transformer, furnishes direct current at 4 amperes to luminous arc lamps with 75 to 80 volts at terminals.

Standard outfits are furnished for 12, 25, 50 and 100 lights to be operated from 25 to 60-cycle 2200-volt circuits.

Complete information furnished on request

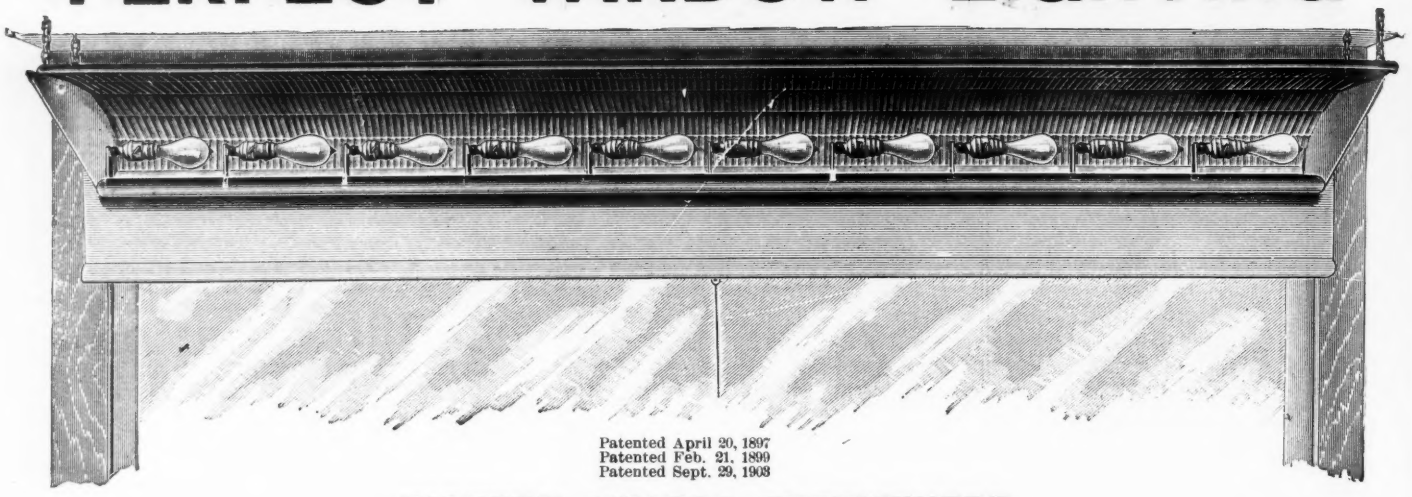
1442

New York Office
44 Broad Street

Principal Office
Schenectady, N. Y.

Sales Offices in
All Large Cities

PERFECT WINDOW LIGHTING



Patented April 20, 1897
Patented Feb. 21, 1899
Patented Sept. 29, 1903

HIGHEST AWARDS EVERYWHERE

FRINK'S SPECIAL PATENT WINDOW REFLECTOR

is designed on thoroughly scientific lines, built of metal, and lined with silver-plated corrugated glass. It is placed at the top of window near front glass, and serves to hide the lamp from the sidewalk, at the same time brilliantly illuminating the windows throughout. Frink reflectors have been installed in hundreds of the leading stores throughout the country, and as an achievement in combining the best materials and skilled workmanship are a big success. It is the only fixture that successfully meets every requirement of window lighting; electrical contractors and engineers have found in it a solution of all their hitherto vexing problems in this class of work. Show windows are an essential feature of modern mercantile buildings, and the consideration and care bestowed upon lighting them is amply shown in the large number of contracts which we are handling for this class of work. A FRINK reflector burns just enough lamps to show up the window display, without adding to the store's expense by helping the city to light its streets. Its reflecting angles are so carefully worked out that the entire illumination from the lamps is confined within the window.

REFLECTORS FOR ALL PURPOSES

GEO. FRINK SPENCER
Manager

I. P. FRINK 551 PEARL STREET **NEW YORK**

Telephone 82 83 Worth

BRIGHTER LIGHT · LIGHTER BILLS · NERNST

BRIGHTER LIGHT · LIGHTER BILLS · NERNST

Another NERNST Victory!

The Scruggs-Vandervoort-Barney Dry Goods Co. have adopted the Nernst System for lighting the finest dry goods store in St. Louis for the same reason that led Marshall Field & Co. of Chicago to adopt it for the finest dry goods store in the world.

Have you read our booklet on store lighting? If not, send for a copy.

NERNST LAMP COMPANY

PITTSBURG, PA.

NEW YORK ATLANTA BOSTON CLEVELAND CINCINNATI CHICAGO
DENVER FT. WORTH OMAHA PHILADELPHIA ST. LOUIS

ALMOST HUMAN
"IT TALKS"

Tell your story in an up-to-date manner

THINK OF IT!!

40 Electric Signs in One

THE TALKING SIGN

(1) Is read by the people
(2) It tells them your whole story
(3) It is the logical way for a central station to advertise
(4) You say to the public, "Use electricity"
(5) We say to *you*, "Practice what you preach"

USE THE TALKING SIGN NOW!

We are manufacturers of (1) Good Electric Signs (2) Illuminated Emblems (3) Flashing Machines (4) Time Switches (5) Photometers (6) Foot and Border Lights (7) Bill Board Reflectors

Our "Iron Clad" Changeable Signs are Winners

WRITE FOR OUR ILLUSTRATED BULLETINS

THE ELECTRIC MOTOR & EQUIPMENT COMPANY

NEWARK, N. J.

Your sign is your best salesman—Get one that talks

Engrave your monogram on the night

With Heat-Resisting NOBLAC Inner Globes you don't need Outer Globes—money saved.

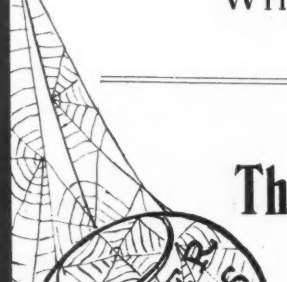
They are made of special heat-resisting glass—need less protection than the "ordinary."

Then again, this same heat-resisting quality makes them non-blackening.

They don't soften.

The carbon particles don't "embed" themselves.

Write for our catalog.

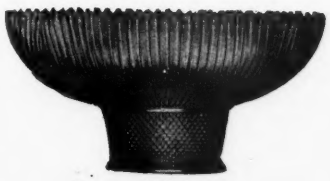


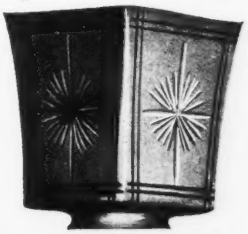
The FOSTORIA Glass Specialty Co.

THIS STANDS FOR QUALITY

MIXERS of GLASS and SCIENCE

FOSTORIA Ohio


9860½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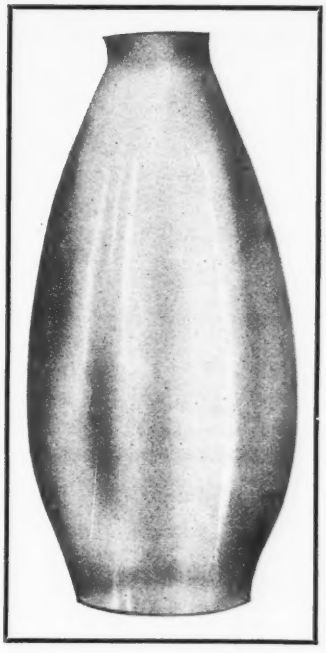

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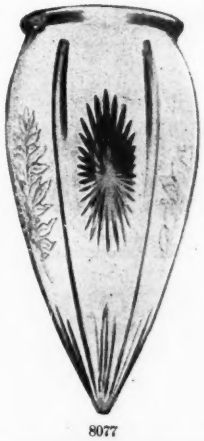
NEW YORK PITTSBURG CHICAGO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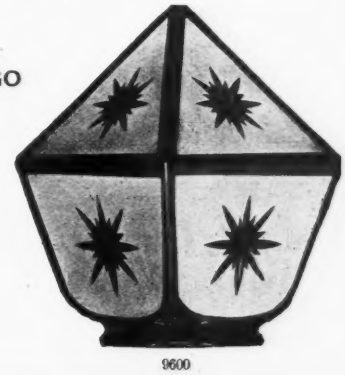
9841½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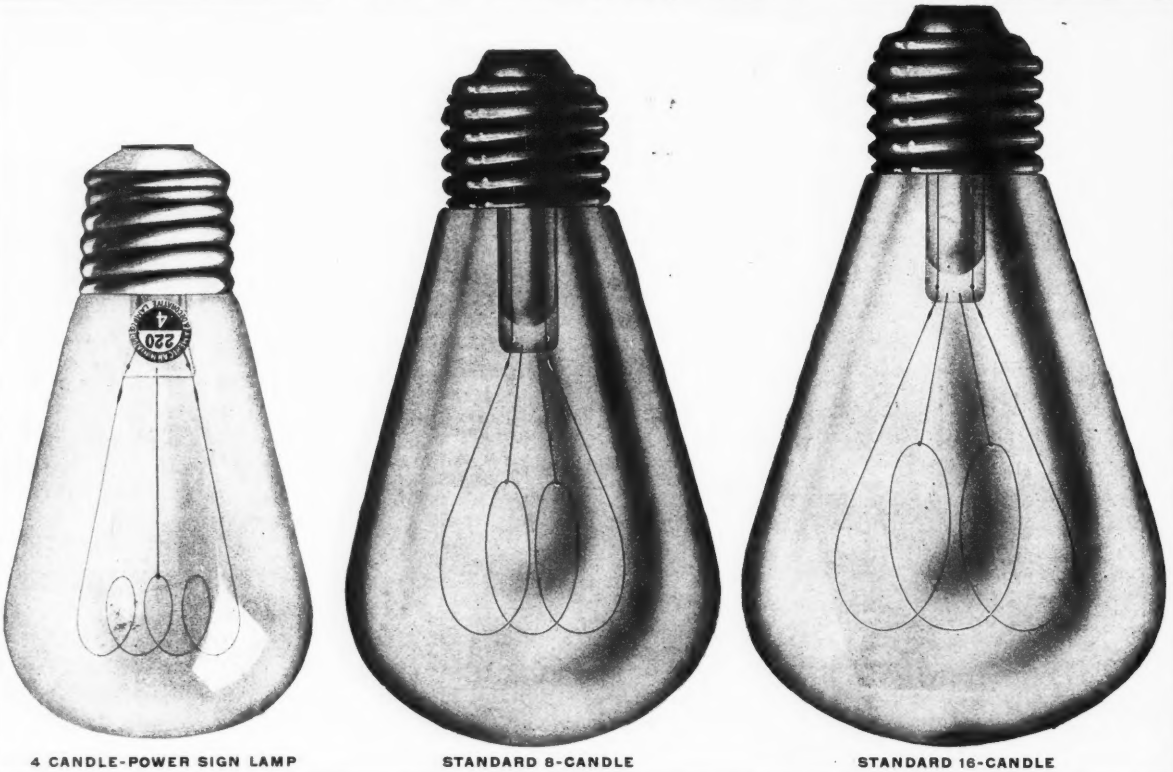
High Volt Tipless Lamps

MADE UNDER H. J. JAEGER'S PATENT, MAY 26, 1903



4 CANDLE-POWER SIGN LAMP STANDARD 8-CANDLE STANDARD 16-CANDLE

The manufacture of *HIGH VOLT LAMPS* is an entirely different problem over the lower volt types. We have made a careful study in that respect, hence we claim 20 per cent more candle-hours, longer life, full rated candle-power, less blackening of bulbs, and far better insulation against short-circuiting. When you are in the market don't forget us. Made also in all the round ball patterns for interior decorations.

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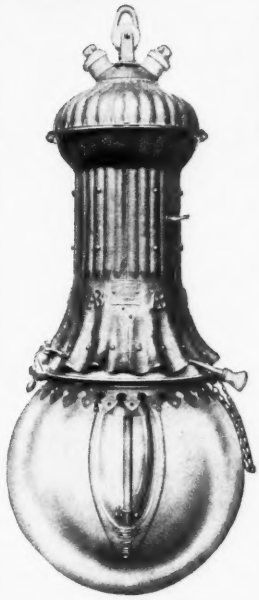

LIGHTING

This is an important subject which confronts nearly every industry. Provision for the fall and winter demands should be made during the summer months.

The merit of a good arc lamp for general illumination is acknowledged. A-B in relation to arc lamps denotes quality. Inasmuch as you can purchase the best for what you are obliged to pay for one of less merit, why consider any other!

Used by the leading lighting companies.

Arc lamps for a'l circuits.

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Eliminate Cost of Trimming and Maintenance

Real live electrical men are ordering them BECAUSE:

They can be used where something more artistic than an arc lamp is wanted.

They cost about the same as an arc lamp and give a far greater illumination.

They can be used where a low ceiling makes an arc impossible.

They can be loaned by Central Stations the same as they do arc lamps.

They can be used to satisfy that "grouchy" arc customer.

They are unaffected by dirt.

And

These are only a few of the "reasons why" YOU should use them.

They are Made for

GEM—
STANDARD—
TANTALUM—
LAMPS

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THERE IS NOT

A BETTER FIXTURE PROPOSITION ON THE MARKET TO-DAY THAN IS CONTAINED IN THE

WAKEFIELD FIXTURES

INCLUDING CEILING CLUSTERS AND BRACKETS

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ONE
TWO
THREE
FOUR OR
FIVE LIGHT
IN ONE STEM

EASIEST FIXTURE TO WIRE

HAS NO INNER IRON BODY

HAS AN EXPOSED OUTLET

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IT
MULTIPLIES
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DECREASES
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AND
STOCK

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THOSE WHO DO AND THOSE
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SHOULD GET IN TOUCH WITH US

SOME OF OUR DISTRIBUTORS:

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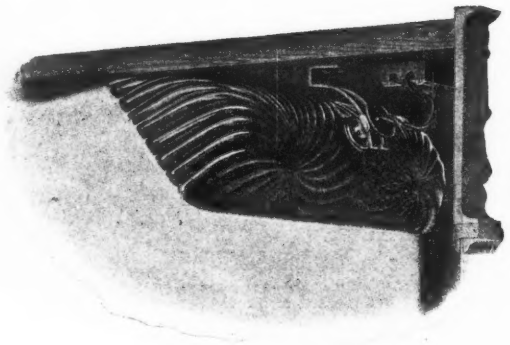
We Lead the World in

The "POKE BONNET" Reflector for All Classes of Low Windows



THE ELECTRICAL TRADE HAS SUPPLIED OVER 4,000 RETAIL MERCHANTS WHO HAVE INSTALLED THEM SINCE FEBRUARY, 1906.

Have you had your share of the business?

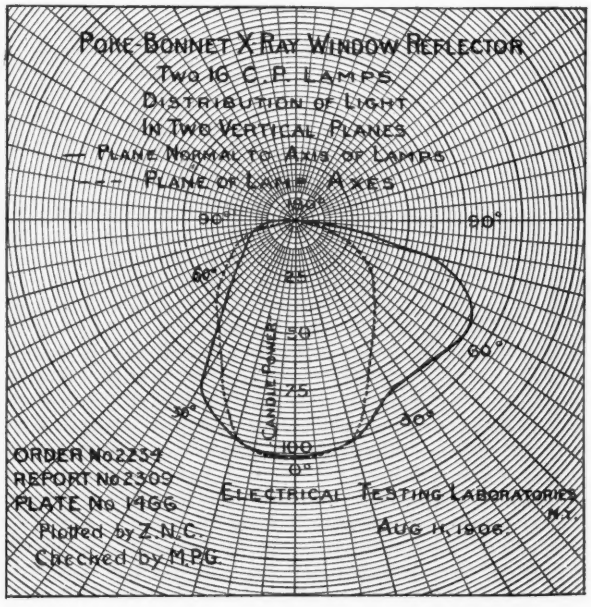
¶ The "Poke Bonnet" Reflector is by far the most efficient reflector ever invented for the low show window. No loss of light by interference of sockets as in common troughs. More durable and easier to clean than sectional mirror reflectors. Saves one-third in current due to proper shape and durable reflecting surface.

¶ The "Poke Bonnet" is always ready for use. Can be kept right in stock and orders filled instantly instead of waiting for long sections made to order. It is about 14 inches long and is fitted with a Benjamin twin socket, which holds two incandescent lamps of any desired candle-power, set horizontally. The reflector is plated with pure sterling silver; no better reflecting surface is known. It does not crack, cloud or craze.

¶ Four "Poke Bonnets," carrying eight lamps, will reflect more light than the ordinary trough reflector carrying twelve lamps.

¶ **The Installation** is simple and quick. The reflector can be adjusted to any desired angle. It is just the thing for low windows and sells the minute it is demonstrated.

¶ The "Poke Bonnet" opens for you a profit-field that has not been worked to death.



NATIONAL X-RAY

245 E. JACKSON BLVD.

Window Lighting

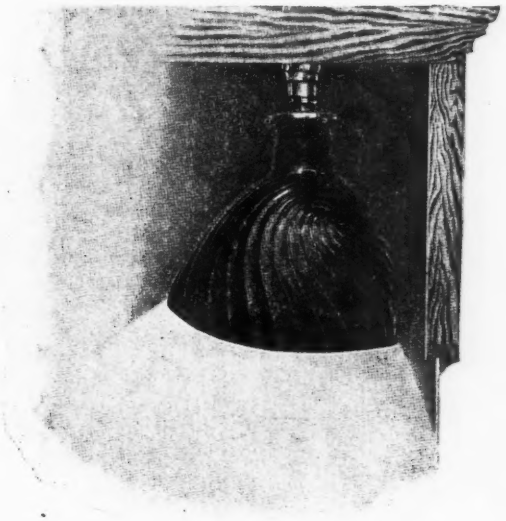
The "HELMET" Reflector (Just Out) for High and Shallow Windows

¶ Built along scientific lines, it has met with instant favor. In the "Helmet" we have the honor and pleasure of bringing out the **first window lighting reflector for high efficiency Gem and Tungsten Lamps.**

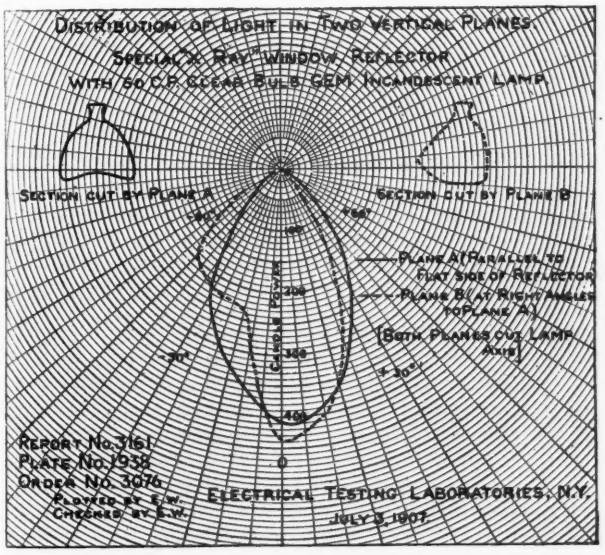
¶ Like the "Poke Bonnet" it is plated with sterling silver. It is scientifically designed to concentrate the maximum amount of light within the window area, hence its remarkable efficiency as shown by the accompanying tests.

¶ The "Helmet" is 12 in. in diameter and is 11½ in. high. It is designed for windows 5 ft. deep with lamps 13 ft. high and others of approximately similar proportions.

¶ For angle covered, see tests below. Over 200 candle-power over a wide angle. Over 400 candle-power toward bottom of window, gradually growing less at higher angles to evenly illuminate goods. Easy to install. Sockets point straight down. Minimum strain on shade holders and sockets. This reflector uses a single 125-watt, 50 candle-power Gem Lamp. Light is concentrated in the window; not a large percentage on the sidewalk. A great current-saver or light-increaser. One "Helmet," with 125 watts, will replace from three to six 55-watt lamps with the common high-window lighting arrangements, and will take the very efficient Tungsten Lamp when it is available.



"HELMET" IN WINDOW (Pane at right)


DISTRIBUTION OF LIGHT IN TWO VERTICAL PLANES
SPECIAL "X-RAY" WINDOW REFLECTOR
WITH 50 C.P. CLEAR BULB GEM INCANDESCENT LAMP
SECTION CUT BY PLANE A
SECTION CUT BY PLANE B
PLANE A PARALLEL TO FLAT SIDE OF REFLECTOR
PLANE B AT RIGHT ANGLES TO PLANE A
BOTH PLANES CUT LAMP AXIS
REPORT No. 3161
PLATE No. 1938
ORDER No. 3076
PLOTTED BY E.W.
CHECKED BY E.W.
ELECTRICAL TESTING LABORATORIES, N.Y.
JULY 5, 1907

¶ With the "Poke Bonnet" for low windows and the "Helmet" for high ones, your sales are certain.

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REFLECTOR CO.

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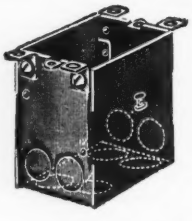

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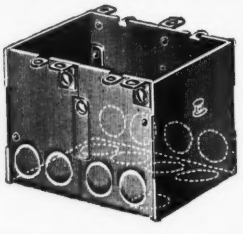

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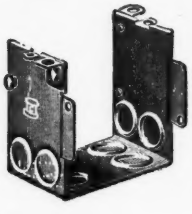

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Ears operate on a screw pivot in a slot and can be adjusted to any thickness of plaster.

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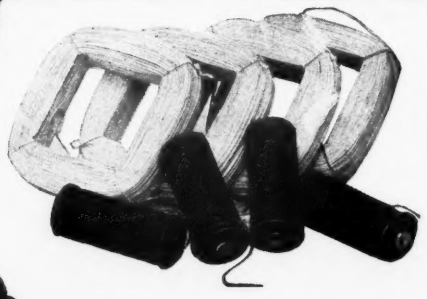

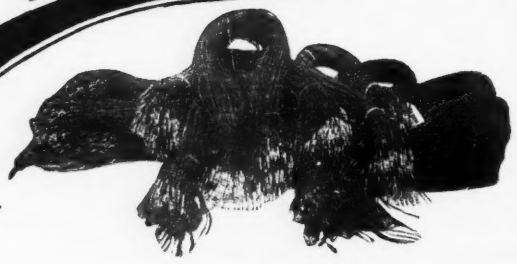

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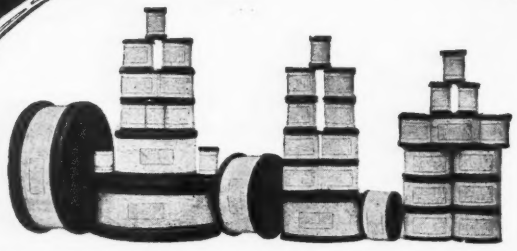

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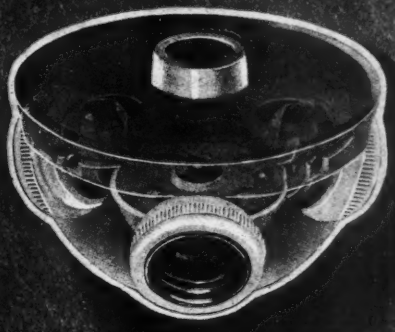

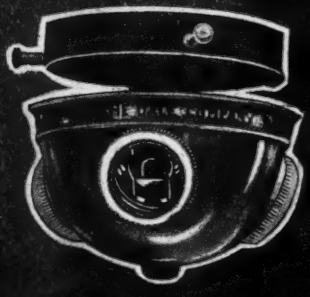

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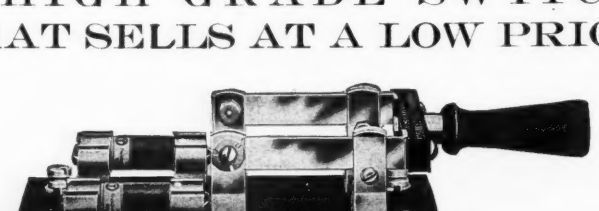

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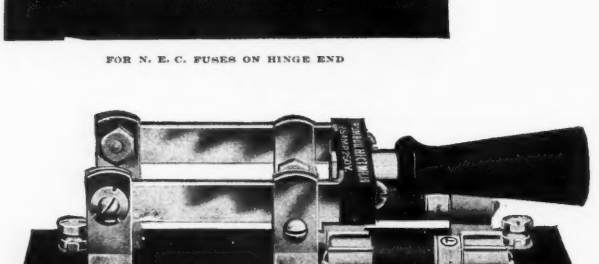

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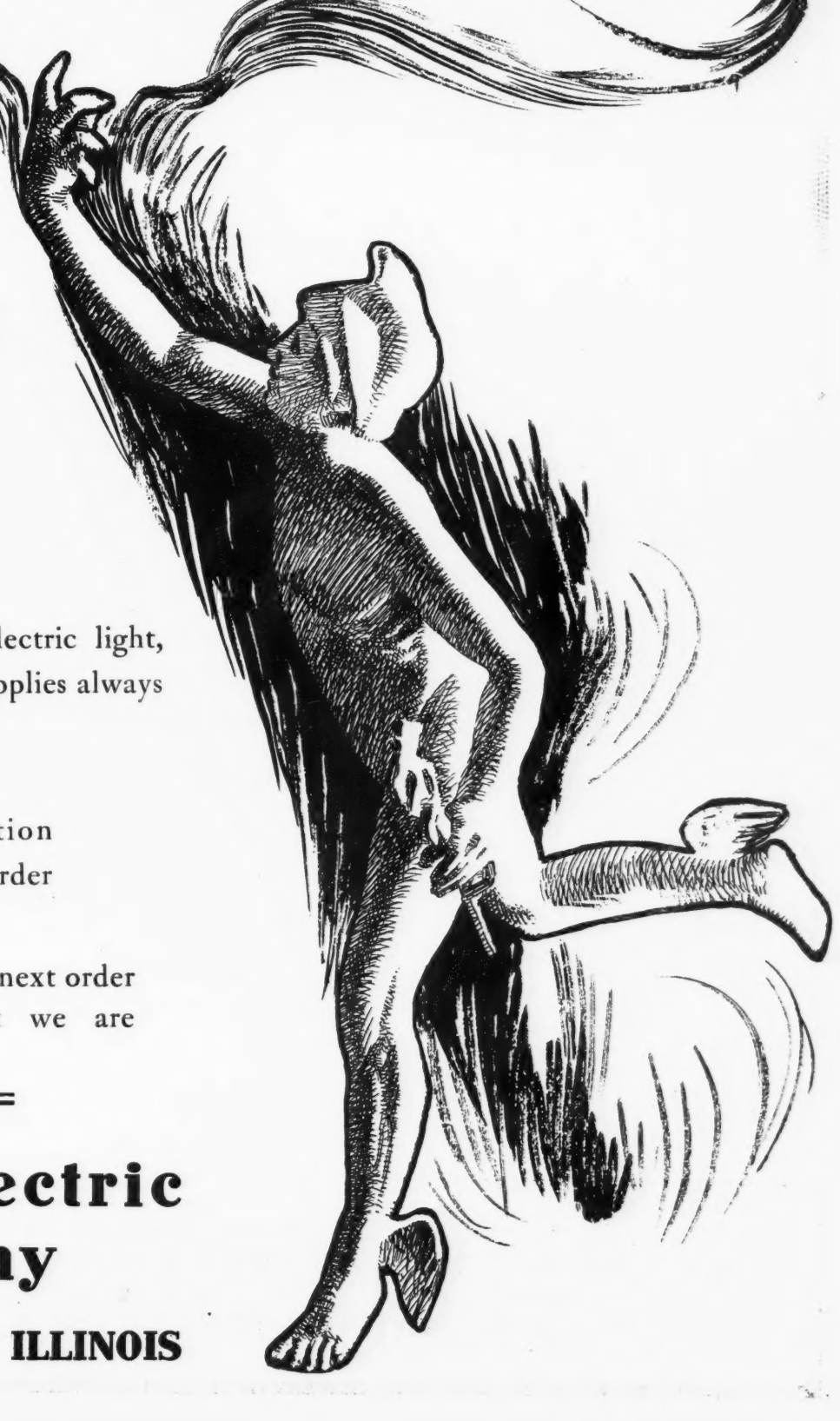

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"Victor" insulators are insurance at any voltage.

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Does the insulation crack or freeze in cold weather?

Does the insulation ravel?

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Progressive engineers and experts throughout the country agree with us that "AMERICAN" instruments mark a distinct advance in the manufacture of such apparatus, and are better than those obtainable heretofore. For this reason, proven superiority, they are using "AMERICAN" instruments. This being true, is it not worth while for every instrument user to investigate our product?

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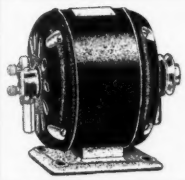

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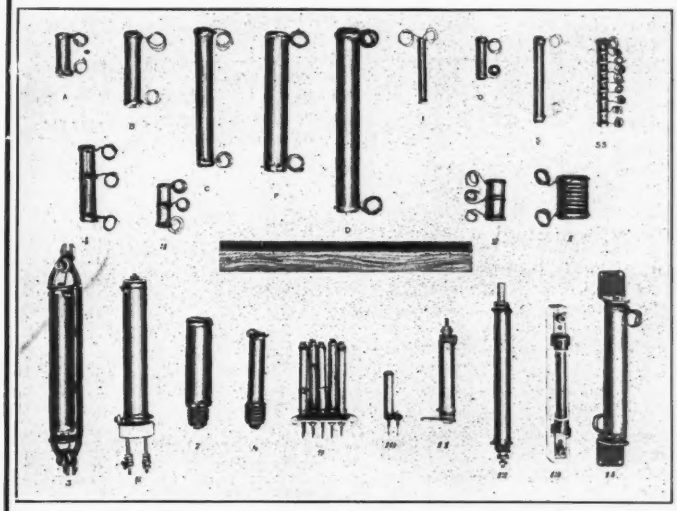

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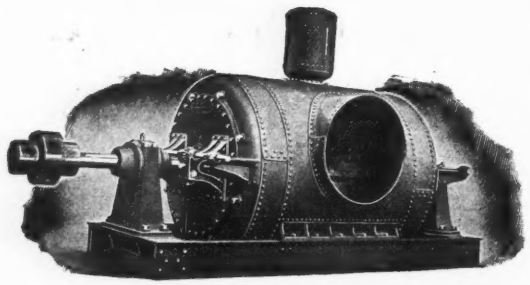

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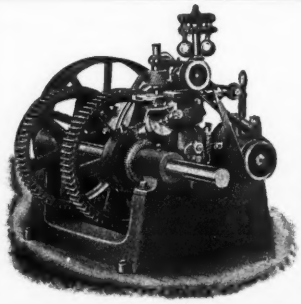

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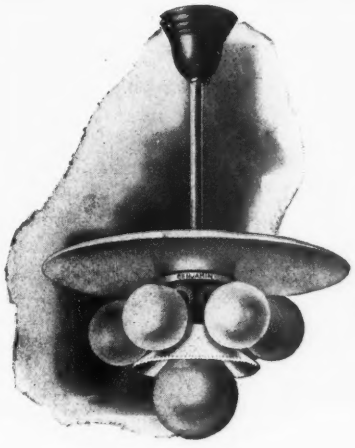

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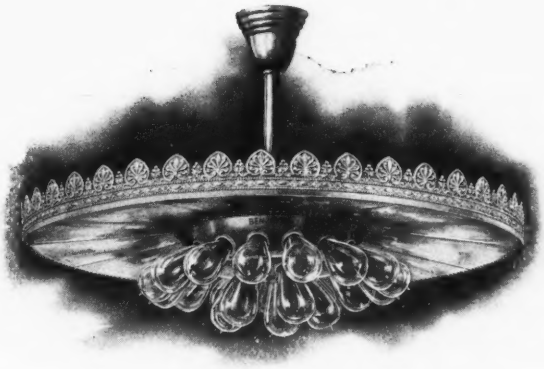

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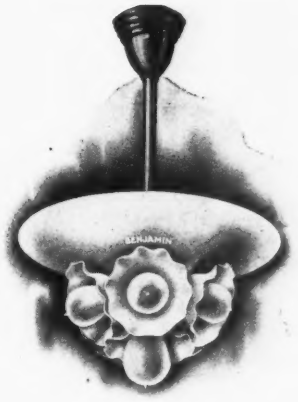

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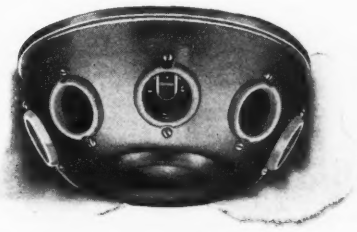

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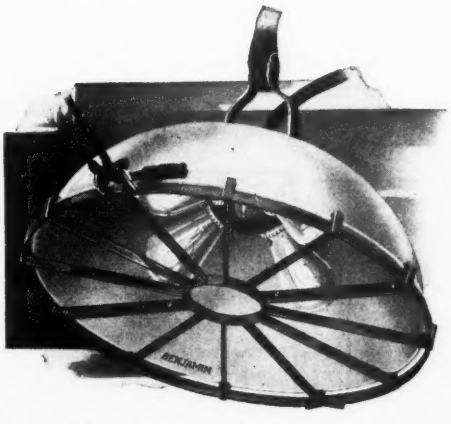

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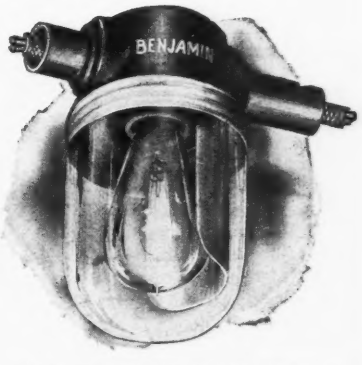

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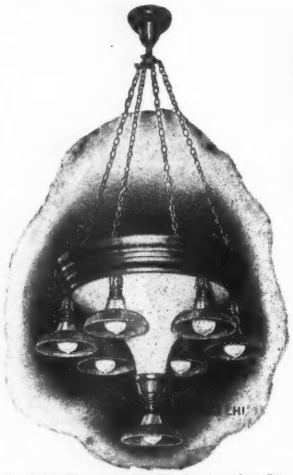

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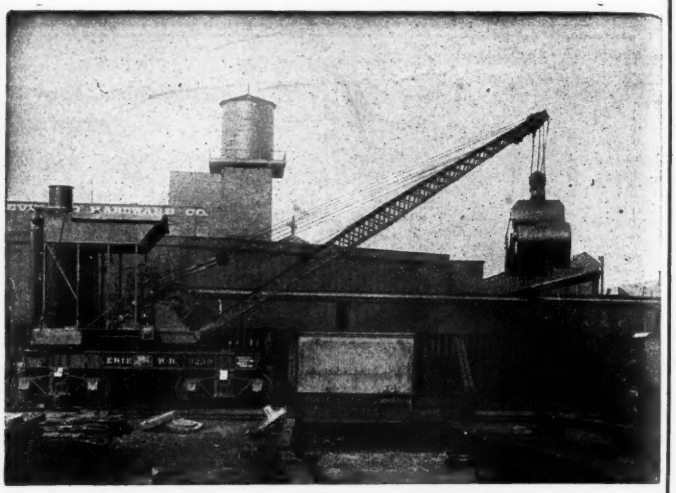

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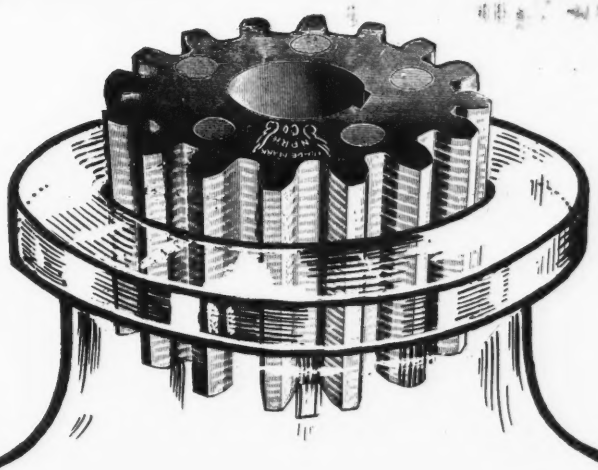

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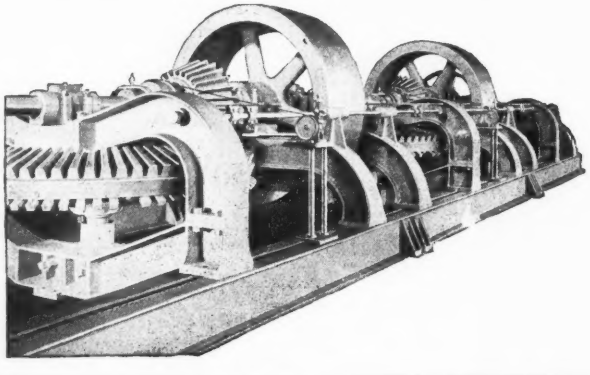

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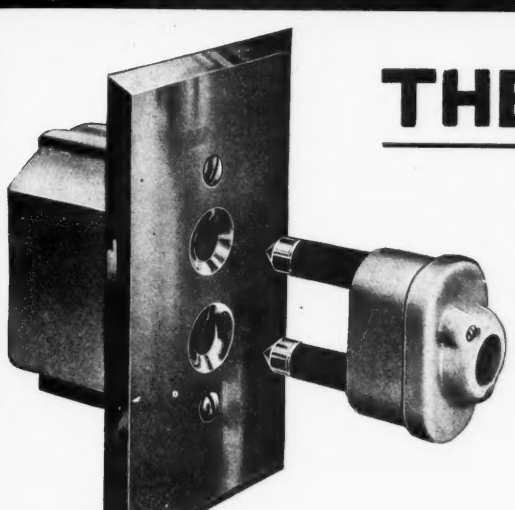

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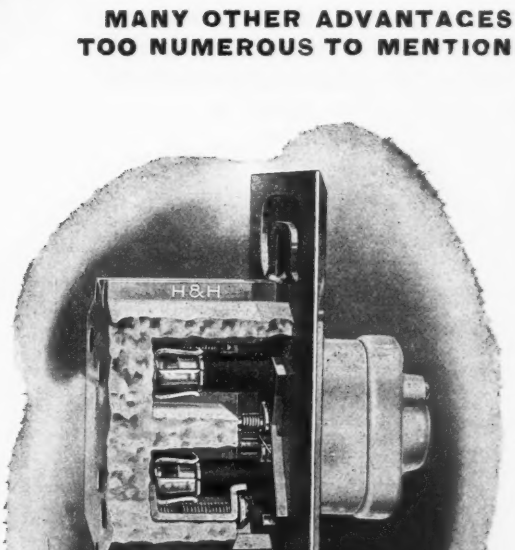

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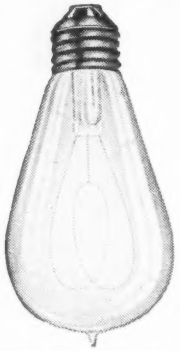

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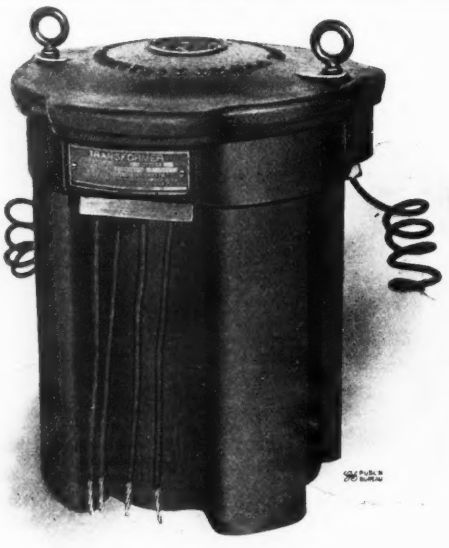

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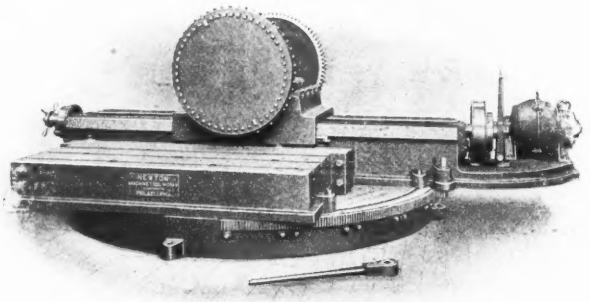

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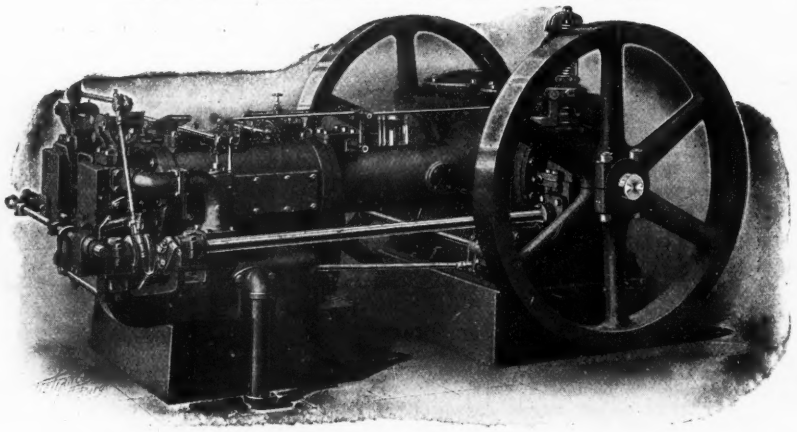

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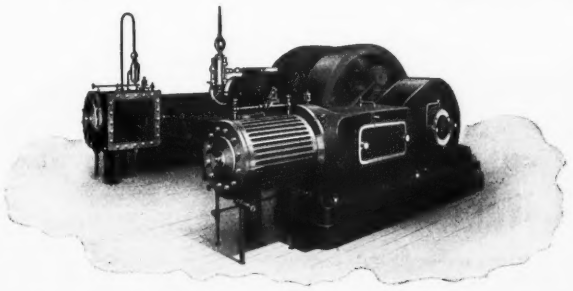

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Schwerdtle Stamp Co., The

STENCILS
Schwerdtle Stamp Co., The

STOKERS
Westinghouse Machine Co.

STORAGE BATTERIES
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General Storage Battery Co.
Gould Storage Battery Co.
National Battery Co.
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Anderson Mfg. Co., Albert & J. M.
Bossert Electric Construction Co.
Doubleday-Hill Electric Co.
Electric Goods Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
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SWITCHBOARD MATS
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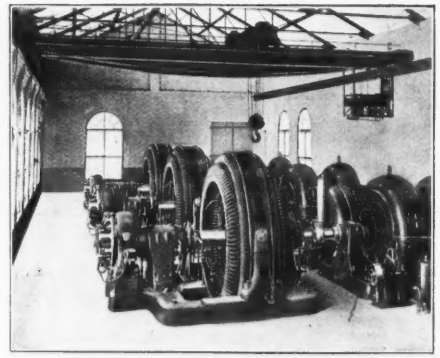

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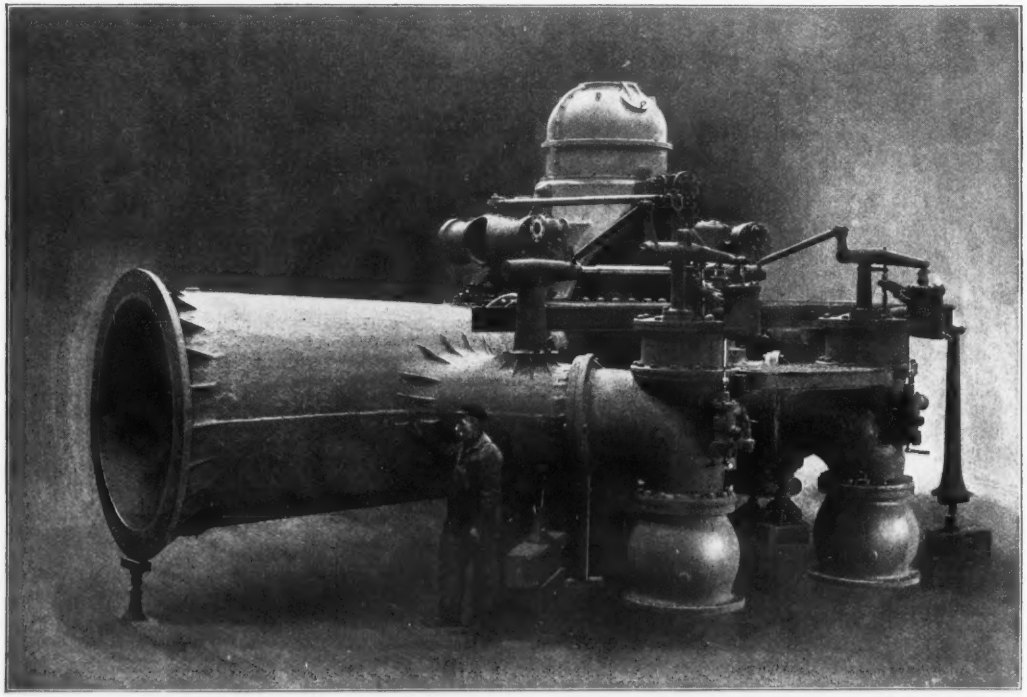

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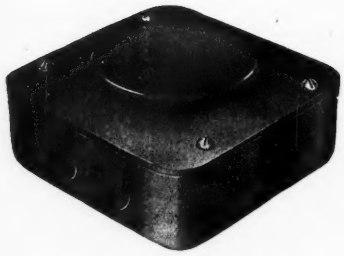

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The use of an
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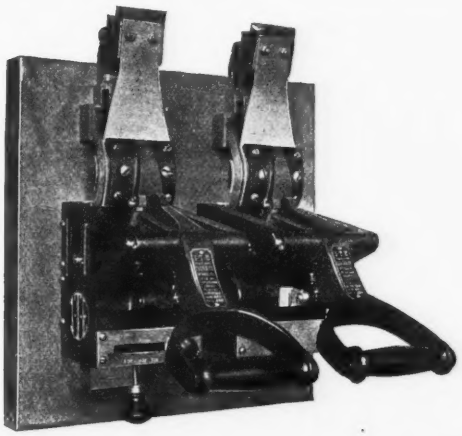
saves money, time and trouble



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Central Station

Mr. FRED A. CURTIS

President and General Manager of our company, the originator of the Curtis plan of direct-by-mail advertising services.

Mr. CHARLES A. PARKER

Secretary, Editor of the *Booster*, originator of much of our electrical advertising, and the advertising we have issued in connection with the Co-operative Electrical Development Association.

The Curtis Advertising Company is a 100-man concern—an organization of "high-efficiency" brains and skill specially equipped to take care of the Advertising and New-Business Campaign of Central Stations, Electrical manufacturers and jobbers.

We have two reasons for publishing these photographs of four men who constitute our own "New-Business" Department.

First—because we want you to know these men—we want you, at your convenience, to meet them face to face—to hear from them, personally, the story of our peculiar ability to serve you.

Will you not let us hear from you as to when you would like to meet one of these men?

Second—because we want to emphasize an important fact;—our organization is not (as some are) top heavy on selling and light weight on "delivering the goods."

These four men, who constitute the backbone of our business-getting department, are, every one of them, themselves producers of advertising, men of ideas, thinkers, men who can help you to plan for the best results from your advertising campaign.

We do not rely on high-salaried spellbinders to get business and low-priced brains to make the advertising.

When you engage an attorney or an engineer, you certainly inquire into his past reputation and success, and, as near as you can estimate, decide whether or not he is capable enough to carry out for you the work you desire done. Don't you?

You are no doubt interested in advertising and new-business-getting ideas for your business.

Doesn't it sound rational that the advertising concern most familiar with the conditions and requirements of your business will give you the best results?

Is it not true, therefore, that you would prefer to purchase advertising matter from this company, which handles twice as much Central Station and Electrical Advertising as all other advertising concerns combined?

Reason it out and we believe you will agree with us that we can render you the most efficient advertising service.

Co-operating with the
Co-operative Electrical
Development Association

CURTIS

Business Boosters

Mr. C. H. JOHNSON

Vice-President of our company, well known among the electrical fraternity, and thoroughly well posted on what our central station customers are doing in their new-business departments.

Mr. F. C. MATHEWS

Assistant General Manager, who is supervising the central station advertising we are now doing for Mexico City, Mexico; Buffalo, N. Y., and others, and originator of much of the advertising we are making for electrical manufacturers and central stations.

At the head of every department connected with our business we have men who thoroughly understand Central Station requirements and who are well equipped to prepare advertising matter that is practical and productive.

For the last ten years we have been in very close touch with everything electrical.

We are, therefore, thoroughly familiar with your business conditions and are able to outline for you a campaign of advertising that will be economical and profitable.

"From brains to post-office" your campaign may be handled by us so that all the details are taken off your hands.

At your command, we have about one hundred people divided into some eight different departments.

Your matter goes from Sales Department to Idea Department, Idea Department to Copy Department, etc., etc., until it reaches Uncle Sam's post-office, stamped and addressed.

All the idea making, copy writing, designing, printing, bindery work, addressing and stamping is done in our plant, and it takes more than twelve thousand square feet of space to accommodate us at the present time.

Examine closely the advertising matter that comes to you now and you will find the mark of Curtis on the best of it.

Request us and we will give you the names of many Central Stations and Electrical manufacturers who will tell you that our advertising service is profitable and satisfactory.

Don't you think it would be a good idea to make an appointment with one of our company and talk the matter over?

We believe you will find it quite satisfactory to discuss new-business-getting ideas with a man who is well posted and thoroughly acquainted with the requirements of Central Stations.

Why not write us now, making such an appointment, setting your own time and date?

We shall be glad to send you our "Short Cut Book" upon request.

ADV. CO.

Office and Plant
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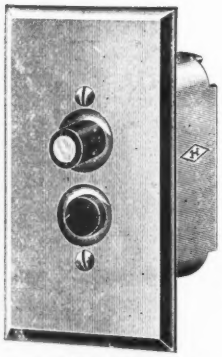
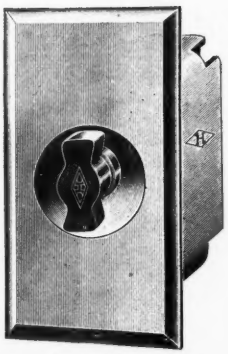


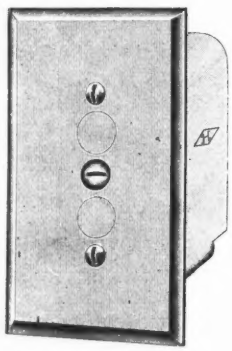
Flush Push Switch

TRADE MARK

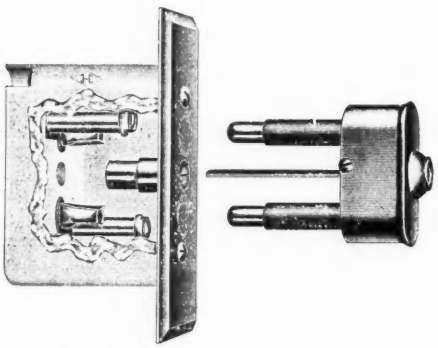


Rotary Flush Switch

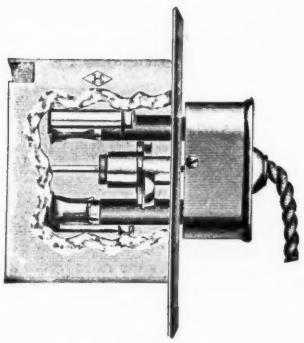
"Diamond H" Switches



Automatic Flush Receptacle



Receptacle Plug



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No. 26.

HORSERACING is, for all the world just like putting your money in meters.

Why? Because nine times out of ten, it is the horse with the power of endurance behind it—the torque, so to speak—that becomes the favorite.

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DUNCAN ELECTRIC MFG. CO.

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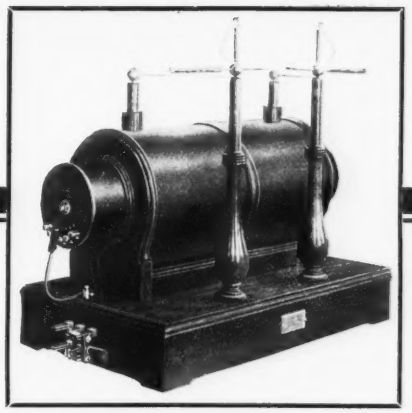

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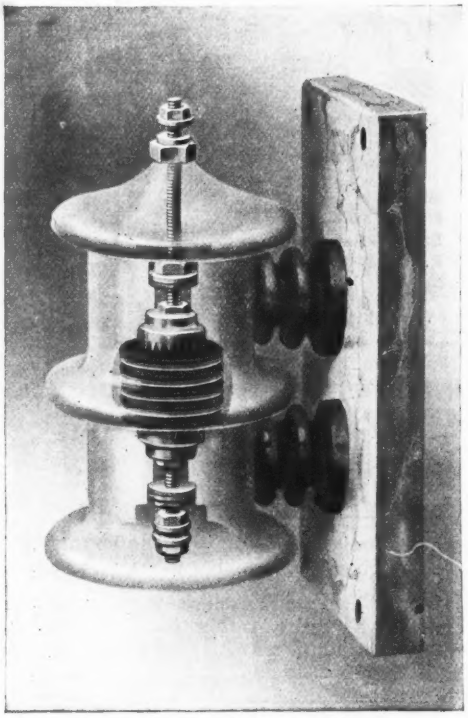

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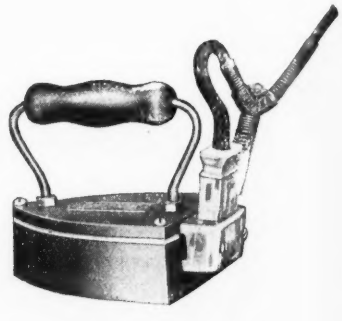

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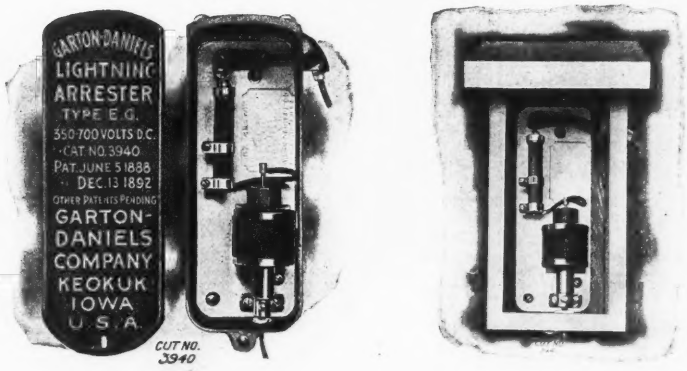

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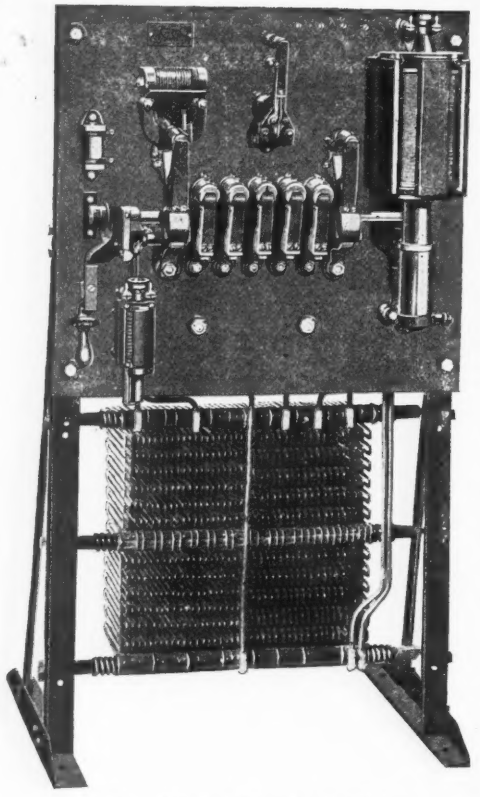

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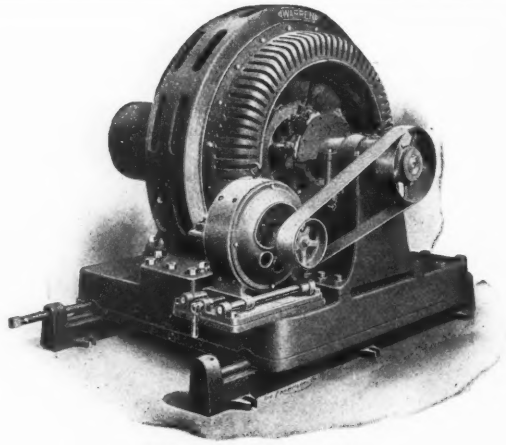

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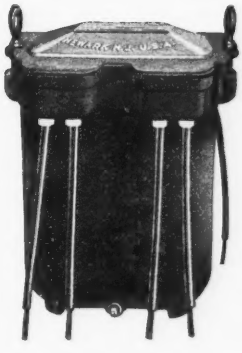

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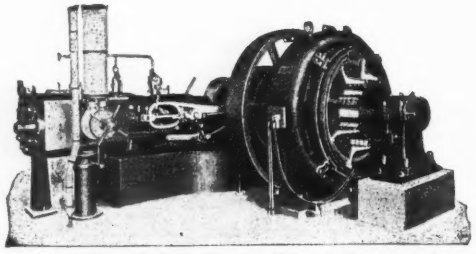

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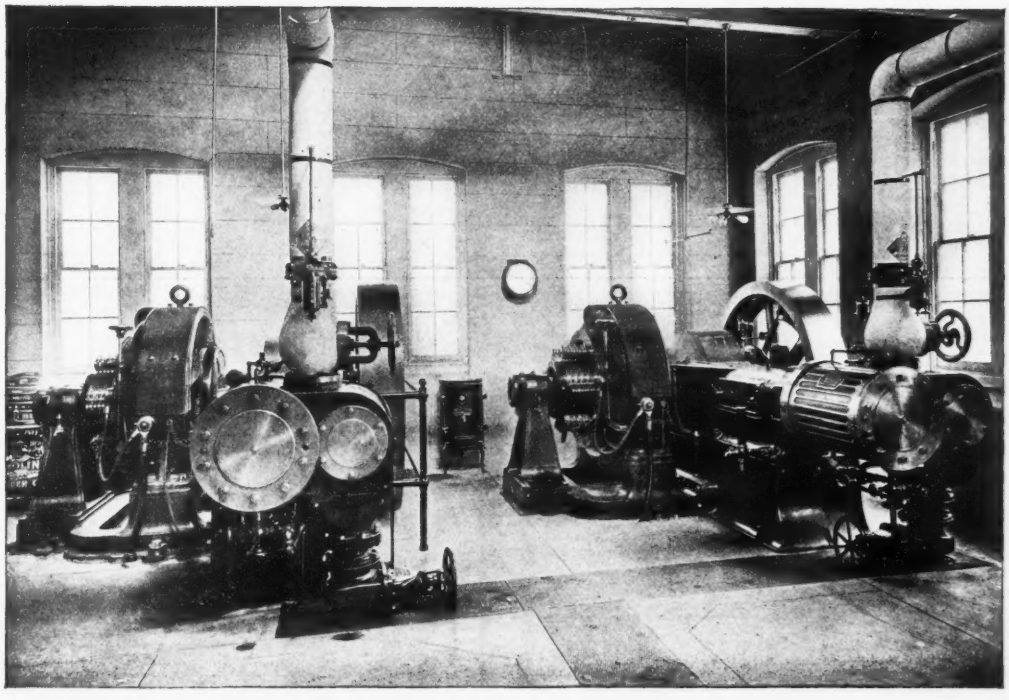

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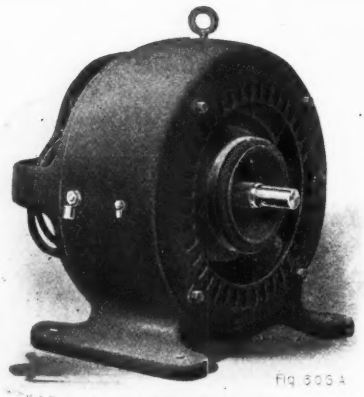

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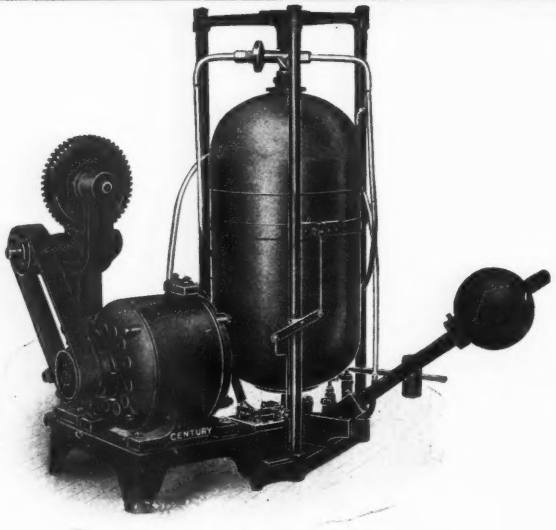

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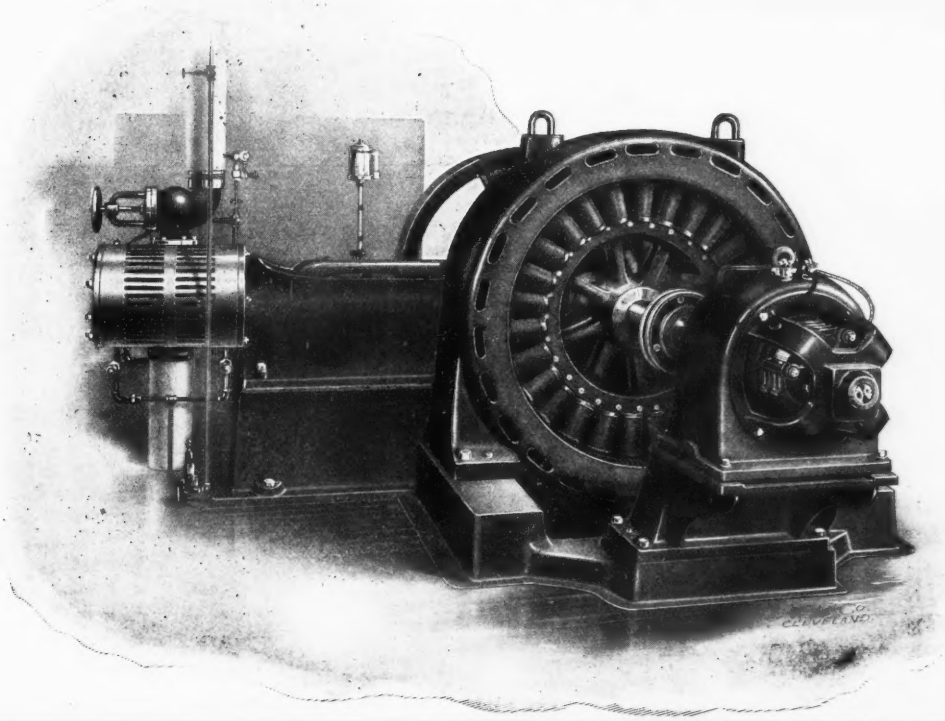

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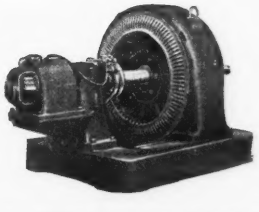

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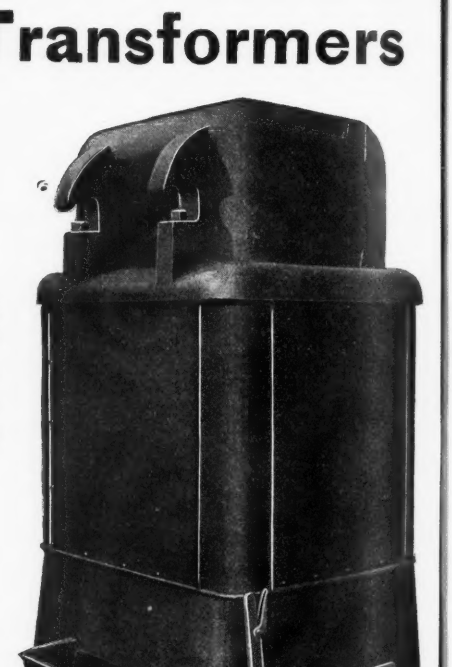

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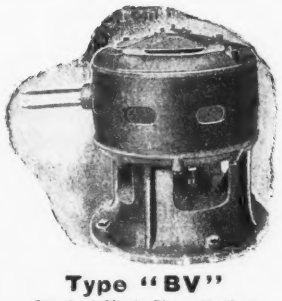

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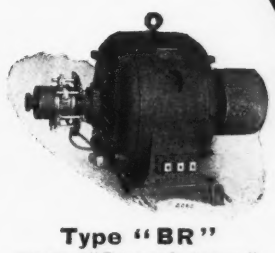

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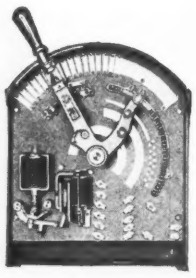
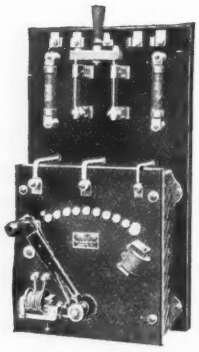
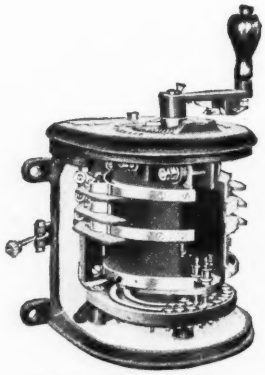


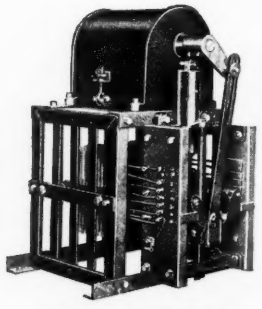
Printing Press Controller. "Carpenter" Type. (Bulletin 85½.)



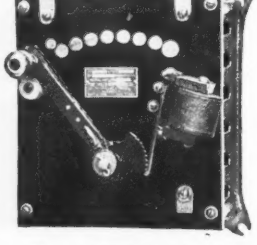
Universal Motor Starter. (Bulletin 21.)



Machine Tool Controller. (Bulletin 78.)

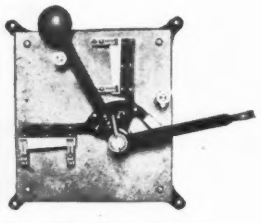


Elevator Controller (Bulletin 54.)

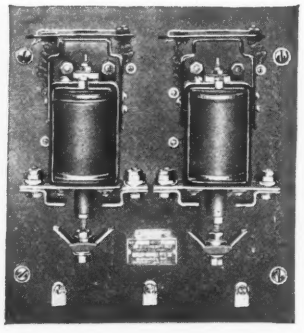


Motor Speed Regulator. (Bulletin 40.)

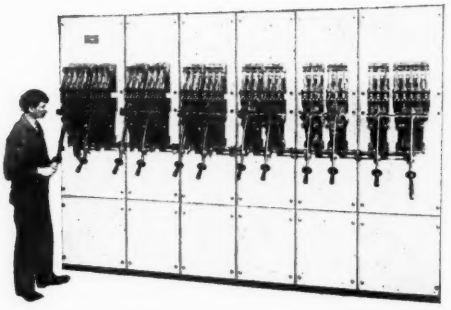
JUST A FEW



Float Switch, for use in connection with open tanks. (Bulletin 73.)



Self-Starter for Motor-Driven Pumps. (Bulletin 73.)



Multiple Switch Starting Rheostat for 1,500 H. P. Motor. (Bulletin 10½.)

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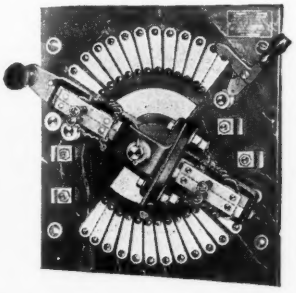
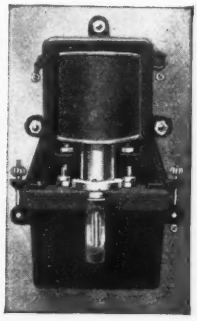
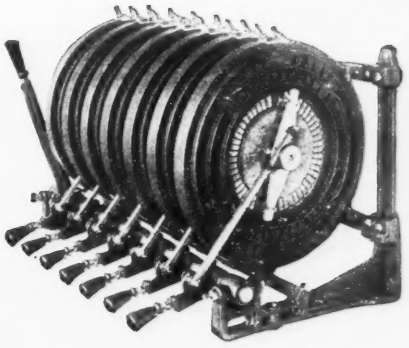


Starting Rheostat for two-phase or three-phase induction motor—squirrel cage type. May be used in place of auto-transformer or compensator with small motors. (Bulletin 18.)

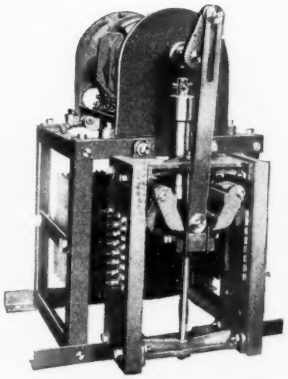


Self-Starter for alternating current motor—single, two or three-phase. (Bulletin 33.)

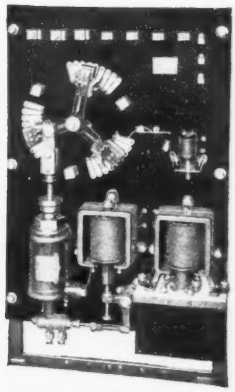


Theatre Dimmer. "Simplicity" Type. May be used on either A. C. or D. C. Circuits. (Bulletin 92.)

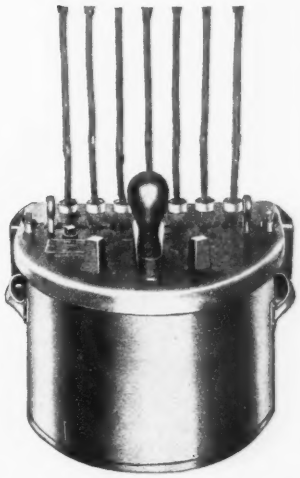
O F T H E M



Elevator Controller for alternating current motor—slip ring type. (Bulletin 56.)



Self-Starter for two or three-phase A. C. motor—slip ring type. (Bulletin 35.)



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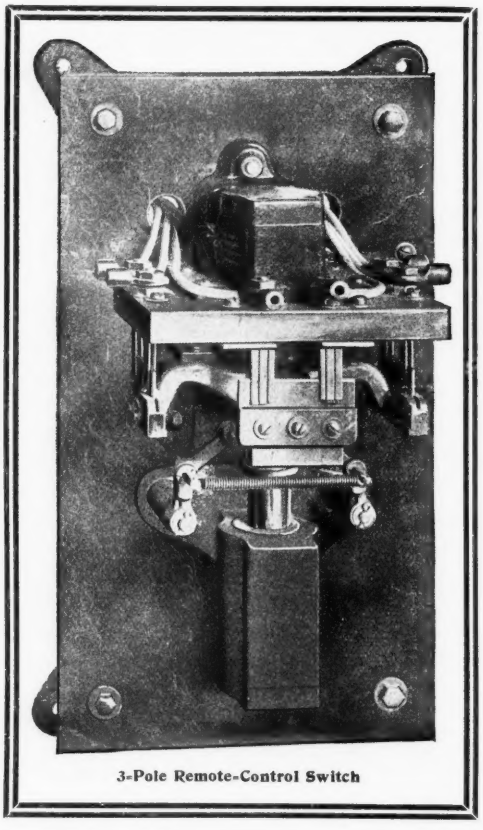
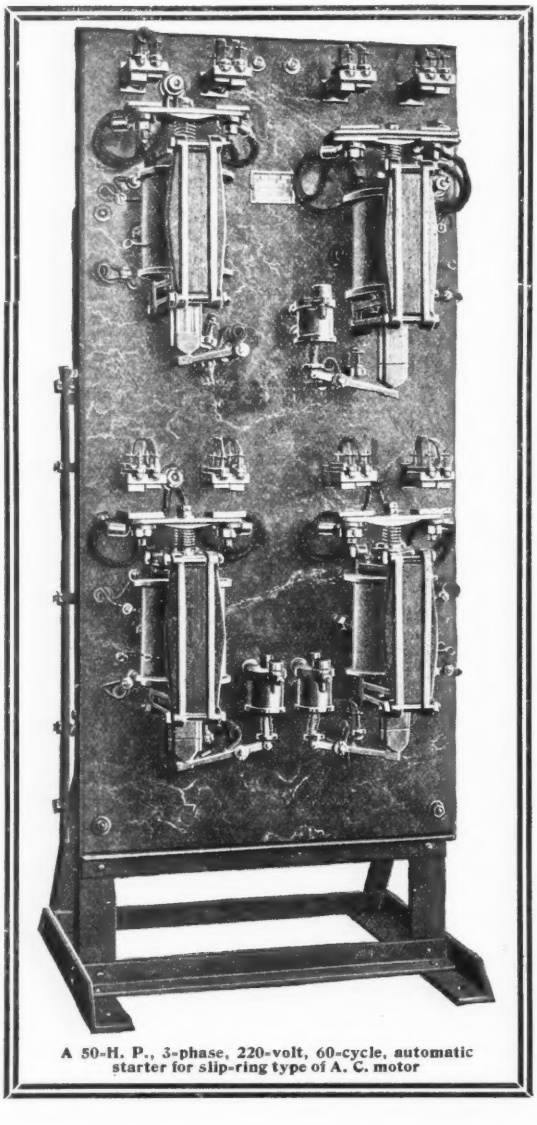


3-Pole Remote-Control Switch



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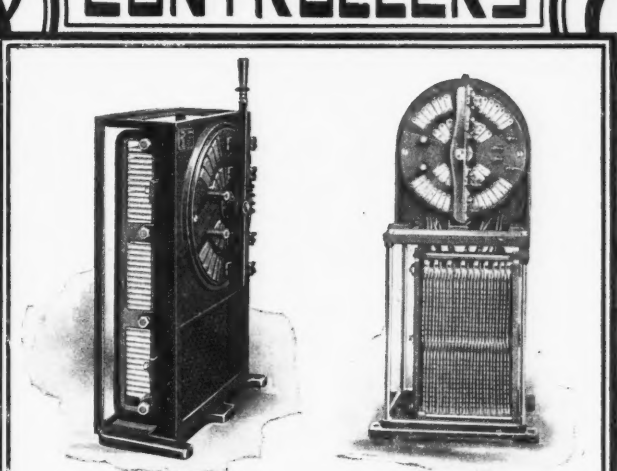

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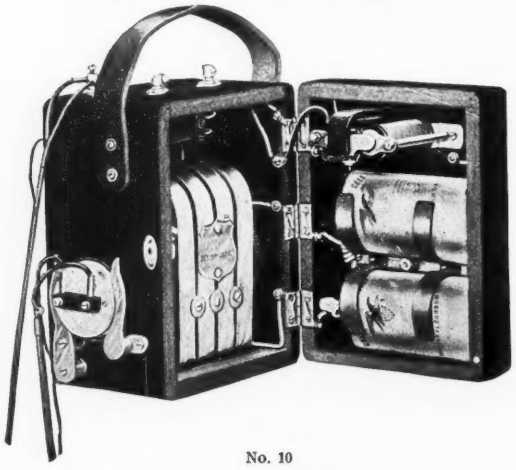

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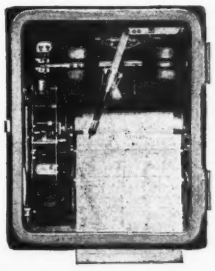

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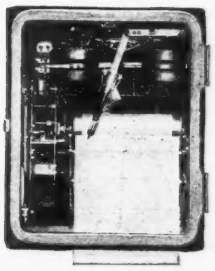

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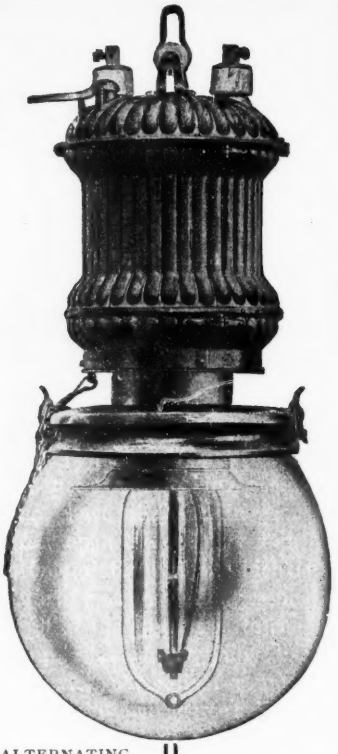

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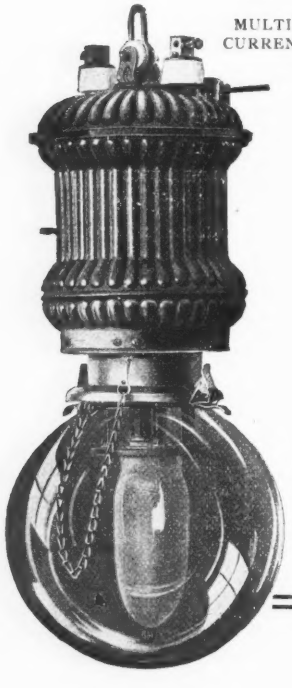

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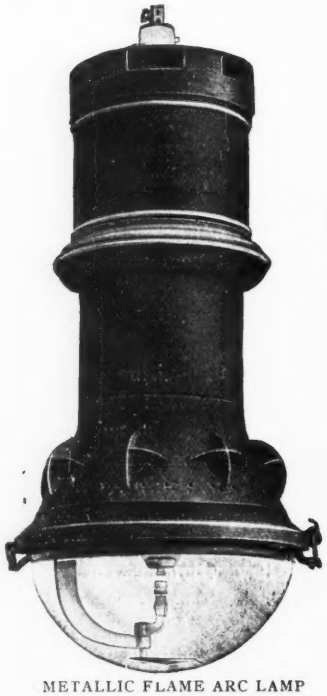

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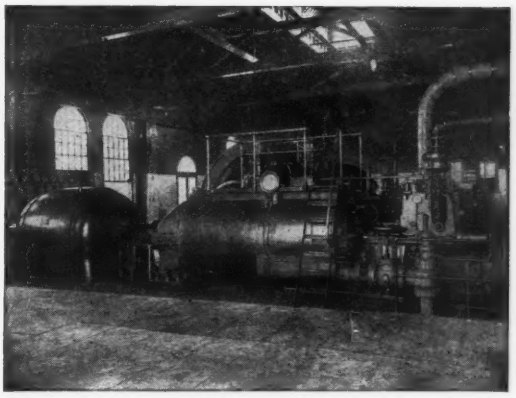

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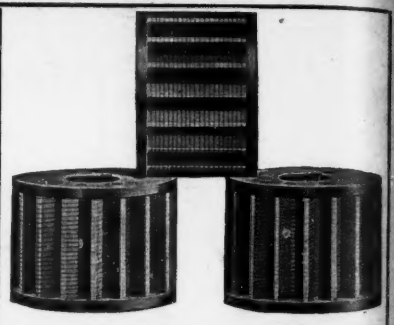

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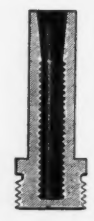

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